

OYSTER CULTURE
ON THE
GEORGE'S RIVER,
NEW SOUTH WALES.

TECHNICAL EDUCATION SERIES, No. 25.



Technological Museum, Sydney.

GEO. HOOPER. F.T.C. Curator.

OYSTER CULTURE
ON THE
GEORGE'S RIVER,
NEW SOUTH WALES.

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Introduction.

THAT there is urgent need for a work of this nature has long been recognised, for daily the Fisheries Department receives inquiries for information concerning methods of oyster cultivation which are adapted to use in the waters of New South Wales, and many such inquiries have also been received at this museum. There has been nothing published in the past which would serve to enlighten those seeking information, and whilst this handbook does not profess to embrace the whole of the methods which are employed in the cultivation of the oyster in our waters, it nevertheless covers a large variety, all of which have stood the test of time on the George's River, and have proved to be eminently suitable for the purpose.

Every method of cultivation of importance which is employed on the George's River is herein described and illustrated. Such information as the position of the cultivation with respect to the tides, the dimensions of beds, stones, logs, &c., the correct distance certain objects should be placed from the bottom, and much other information useful to the practical oyster cultivator, is accurately detailed. It does not fall within the scope of this small handbook to describe the life history of the oyster, its development, the pests to which it is subject, and the causes of its decline and ultimate death. The author is engaged in the preparation of such a work, but so much investigation still remains to be carried out that a considerable time must elapse before its completion. It was, therefore, considered advisable in the meantime to place before oyster lessees the information herein contained, which will serve to assist them in the more practical side of their calling, until such time as the more complete work shall be available.

The George's River was chosen in the first place because it is typical of the majority of our coastal streams, and because cultivation there has reached a very advanced state. In spite of its relatively small length of foreshore, the output was exceeded only by that of Port Stephens and the Hawkesbury River in 1919, the last year of which an official record has been published. Then, too, there is probably a greater variety of cultivation on this river than on any other in the State.

Moreover, the George's River has from very early times been noted for the size and quality of its oysters. For this the freshwater streams which feed it are mainly responsible. Taking its rise at Appin, north of the Cataract dam, it drains an extensive catchment area as it winds north through the district of Liverpool. Its principal tributary, the Woronora, which has never been known to go dry, pours large volumes of fresh water into the main stream at Como, a distance of about 5 miles from its entrance into Botany Bay. The Prospect Creek also contributes a continual supply, in addition to which are several minor creeks. The result is that the George's River has usually a low degree of salinity compared with sea-water, and it is for this reason that the oysters thrive so well, for in water of high salinity the greatest degree of development is never attained.

In describing oyster cultivation on the George's River, I have divided the subject matter into two main parts. The first deals with the progress of the industry from the early days of the Colony and traces its gradual development right up to the present day. The second treats of the actual methods of cultivation employed at the present time. Both are intended primarily for the practical oyster cultivator, though there will probably be found much information to interest the layman, whose knowledge of how his favourite dish is grown is, I fear, usually negligible.

To the practical man the section devoted to the development of the industry contains much more useful information than would perhaps at first sight appear, for a knowledge of the natural state of our rivers before artificial cultivation began, and the many and varied vicissitudes through which his older confrères have passed, cannot fail to be of practical value, inasmuch as it will warn him of the numerous pitfalls to be avoided. It will also serve to remind him that there are ever-recurring pestilences to be overcome, and that, if success is to reward him, his work must receive his constant and undivided attention. Given this, his labours will not be in vain, for the experience of others in the past has proved that a rich harvest awaits the intelligent, progressive and industrious cultivator of oysters in our waters.

Acknowledgment.

I WISH here to express my gratitude to Mr. A. W. Wood, Officer-in-charge of the Fisheries Department, for his generous assistance in placing the departmental launch at my disposal, and for suggestions and data which have been embodied in the succeeding pages ; to Mr. G. A. Edwards, Inspector of Fisheries at George's River, for his assistance when working over the leases, and also for valuable information which at all times he has been most ready to impart ; to Messrs. W. E. Smith, J. S. Smith, F. Selmon, Andrew Derwent, and other lessees for permission to photograph their leases and for much useful information ; to Mr. George Hooper, Curator of the Technological Museum, for kindly reading the proof sheets.

The first part of the handbook, entitled "The Development of the Industry," was compiled from the Annual Reports of the Fisheries Department, Royal Commission Reports on the Fishing and Oyster Industries of New South Wales, and corroborated evidence of the above-mentioned lessees.

The photographs illustrating the text were taken by the author in April and May of 1921.

OYSTER CULTURE

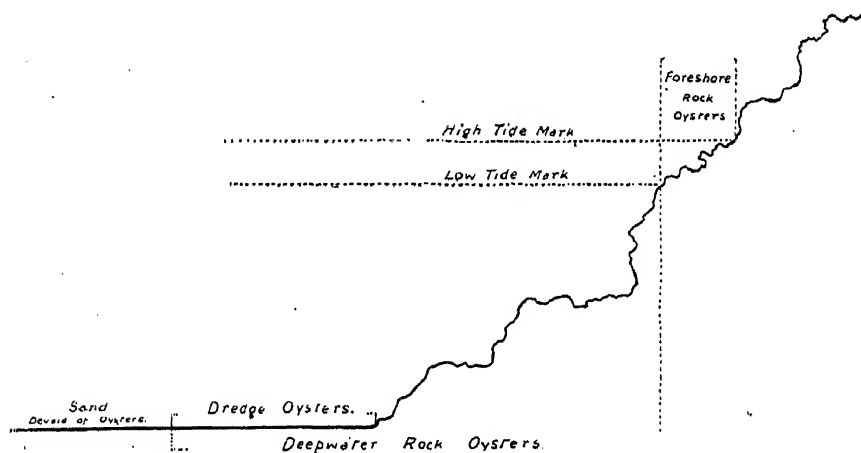
ON THE

GEORGE'S RIVER,

NEW SOUTH WALES.

1. The Development of the Industry.

IN order to understand clearly the various methods adopted for recovering the oysters from the river in the early days of the Colony, it is necessary that the reader should have some knowledge of the situations where they thrived. For this purpose a section of a rocky foreshore, typical of many parts of George's River, is here reproduced.



(Fig. 1.)

From this diagram it will be seen that the oysters grew not only on the rocks between tide marks, in which situations they were known as foreshore rock oysters, but also on rocks from low tide mark to depths of, say, 40 to

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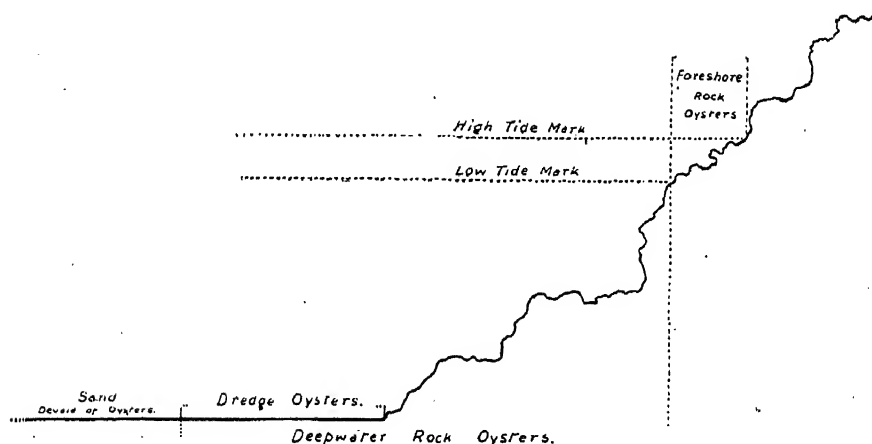
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50 feet, where they were known as deepwater rock oysters. Between these submerged rocks and the bed of the river there frequently occurred patches of level bottom of a gravelly or shelly formation, and in such situations the oysters grew prolifically. Owing to the fact that these were recovered by means of the dredge, they received the name of dredge oysters, but it must be clearly understood that the terms "dredge," "deepwater rock," and "foreshore rock" are only local names for the one species of oyster* growing in the localities designated by the prefix. There was found, however, in situations similar to those occupied by the deepwater rock oysters, another species, known as the mud oyster.† This usually occurred loose on the rocks, in the crevices, or amongst the dredge oysters in the channel, and was occasionally found attached to the rocks.‡

In addition to the above localities known as rocky foreshores, where oysters abounded, there were large areas, particularly near the mouth of the river, where the bottom consisted of gently-sloping mud, and where there was a distance of hundreds of yards between high and low tide marks. In such situations the mangroves grew, but always in the vicinity of the high-tide mark. To the bases of these mangroves and to their myriads of aerial roots, known popularly as "cobblers' pegs," the oysters became freely attached, though they never attained the size and healthy condition of those growing nearer the low-tide mark. These were known to the lessees and the trade as mangrove oysters, but they, too, were the same species as those growing on the rocks.

When the population of Sydney was small the oysters grew in great numbers in the situations above described, but with the advent of population the market demand for them continually increased, and George's River, owing to its close proximity to Sydney, received the early and particular attention of those engaged in the trade. Moreover, picnic parties and the public generally removed what oysters they required indiscriminately, with the result that very early the foreshores were practically bare of adult oysters.

Resort was then had to the gathering of those growing in deep water. Experience had taught local fishermen and others where well-stocked grounds suitable for dredging existed, and in the late sixties of last century the first use was made of the dredge. This was similar to that employed in other countries

* *Ostrea cucullata*, Born.

† *O. angasi*, Sowerby.

‡ The mud oyster has never been of any value commercially, owing to the fact that it is of inferior flavour, and its keeping qualities are very poor. Whilst under ordinary conditions the rock oyster will remain in good condition out of water for a couple of weeks, the mud oyster will only survive for a day or so. For this reason they were either thrown back into the water or collected for lime burning. They gradually became scarcer in the George's River until, at the present time, there are none at all to be found alive, though their shells are to be seen in large numbers. These are used by the lessees as a top-dressing for maturing beds.

for the gathering of deepwater oysters, and varied in width, according to the nature of the ground traversed. On a bottom known to be clear it was used up to 4 ft. 6 in. wide; on ground where an occasional rock or other obstruction might be encountered, a narrower one, 2 ft. 6 in. wide, was substituted. The depth of water dredged varied from about 14 feet to 40 or 50 feet.

In water from, say, 5 feet down to about 15 feet, tongs were largely employed for lifting the oysters, and proved to be satisfactory at those depths.

The dredge was used without thought of the future supply, consequently a few years after its introduction the beds on which it was used were practically bare. Moreover, the foreshore rock oysters were given no chance to recuperate from the early ravages of the lime-burners and the continued depredations of the public. The Government, therefore, realising that the oysters were threatened with extinction, closed the river in about 1870 against their removal for a term of some years.*

At the expiration of this period the oyster-bearing grounds were again fairly well stocked, and tenders were called for the lease of the whole of Botany Bay, George's River, and its tributaries. The successful tenderer was A. Emerson, at the rate of £131 per annum. He established a depôt as his headquarters in O'Connell's Bay, and employed men to gather oysters from the foreshores, and to dredge for those growing in deep water. When the latter again became scarce Emerson purchased a diving-dress and engaged men to dive and gather oysters from those parts of the river unsuited for the dredge. He also employed South Sea Islanders for the same purpose. These men dived only in shallow water where the depth did not exceed 15 feet. Emerson used his diving-suit for some years, and in 1876 had twenty to thirty men in his employ. He paid 6s. per bag to his divers, but the latter had to find the labour for working the apparatus.

For the gathering of foreshore oysters Emerson paid only 4s. per bag, with the result that, in order to make wages, the men collected mature and immature oysters alike, and this proved to be a big factor in once again depleting them. So scarce did they become that in 1874, Emerson, in order to ensure a continuance of the supply, stocked an old natural bed in front of his residence in O'Connell's Bay with undersized oysters obtained from Port Hacking and Cowan Creek. This bed was about a quarter of a mile in length by 150 yards in breadth, and carried several thousands of bags of brood. In the space of two and a half years these developed into fine, large, well-flavoured oysters.

It may be noted in passing that, owing to the salinity of the water, the Port Hacking oysters never grow to marketable size, but if transferred to water

* I am not able to give the exact dates of the events which happened at and before this time, owing to the fact that the papers relative to them were destroyed in the Garden Palace fire, in 1882.

of less density, such as George's River, they quickly thrive, put on fresh growth and, in the space of a couple of years, can scarcely be distinguished from those raised locally.

Reverting back a year or two, one's attention is focussed on an interesting experiment begun by the Hon. Thomas Holt in the early seventies. Holt had visited France, and had seen the methods used there in the cultivation of oysters, and was particularly impressed with the French scheme of digging drains and channels, known as claires, in which the oysters were placed to fatten. Consequently, he constructed claires (Fig. 2) at Gwawley Bay, which he privately owned. These were of uniform width of 22 feet, aggregated some 30 miles in length, and no expense was spared in making flood-gates and dams according to the French system. Many thousands of pounds were expended in their construction, and for some time upwards of 200 men were employed. The depth of these channels was so regulated that from about 4 inches to 2 feet of water would lie in them at low tide. The oysters for stocking them were obtained from Port Hacking, Cowan Creek, Brisbane Water and Pittwater. They were laid on the bottom, but for several reasons did not thrive. In the hot summer months the heat of the shallow water killed many, whilst great quantities became silted over with mud. Consequently, the flood-gates and dams were dispensed with. This not only saved a considerable expense of management, but also made a great improvement in the oysters themselves. It soon became apparent, however, that the scheme would not pay, and, consequently, in the course of two or three years, was abandoned. Those oysters which did survive grew into very large and very fine specimens, and brought top price in the Sydney and Melbourne markets.

The highest price obtained for oysters in the '70's was 30s. per 3-bushel bag. Large quantities were, however, disposed of for a few shillings per bag, so that the average price would probably be in the vicinity of 15s. This low return was due to the inclusion of a large proportion of immature oysters.

Frequent complaint was made against the gathering of undersized oysters and the over-dredging of the natural deepwater beds, with the result that, in the late '70's, the river was closed against dredging. So serious did the indiscriminate gathering of oysters become, not only on the George's River, but also on other parts of the coast, that in 1884 an Act of Parliament was passed for the preservation and culture of oysters. This regulated the gathering of them, the leasing of beds, and penalised the burning of live oysters for lime. It also provided that land below high-water mark could be leased for not less than ten nor more than fifteen years. The right to hold such lease was to be determined by auction or tender, and all oysters raised from land so leased were to be subject to the scale of royalties prescribed by the regulations and approved by the Commissioners.* Every such lease vested in the lessee the

* In the case of George's River, the royalty imposed was 2s. 6d. per bag of 3 bushels.



Photo by

the Author.

FIG. 2.—PRESENT-DAY VIEW OF THE CHANNELS OR CLAIREs CONSTRUCTED IN ABOUT 1870.
THESE WERE ABANDONED AFTER A TRIAL EXTENDING OVER A PERIOD OF
TWO OR THREE YEARS.

exclusive right during its currency of laying and planting, and of dredging and taking oysters, except for the purpose of burning for lime, in and from the beds.

Dredging licenses not transferable were issued for a term of one year (but renewable from year to year). These authorised the holder to dredge for and take oysters in leased lands and in such waters and on such beds not under lease, and at such times as an inspector might appoint.

Every person who gathered or burnt live oysters for the purpose of converting the shells into lime was made liable to a penalty not exceeding £50.

The dredging or taking of oysters at any time between sunset and sunrise was prohibited under a penalty of £20.

On the 12th June, 1883, the deepwater beds were re-opened to dredging, and from then till the end of the year 926 bags were marketed, and this again depleted the dredging beds. Moreover, the oysters growing on rocks below low tide-mark were also fast diminishing in quantity, for whereas in 1879 the divers collected at the rate of about six bags per day, in 1883 the output was reduced to two bags daily owing to their scarcity.

The Oyster Fisheries Act of 1884 was of very considerable benefit to the industry, for it prevented the promiscuous dredging of oysters under license, which had been working such havoc both on the natural beds and the foreshore deposits. For this there was substituted the more equitable and more economic system of distributing the oyster-bearing areas amongst persons who were willing to hold them under lease of lengthened tenure, and devote themselves to the not unprofitable work of cultivating and producing oysters as a means of livelihood; the Crown on its part affording to the lessees absolute control over their leased areas, and complete protection against trespass.

Lessees held their leases at a very nominal rental—only £1 for every 100 lineal yards of foreshore, and as these areas in some instances extended into deep water 600 yards, and on an average quite 300 yards, a considerable superficial area, from 6 to 12 acres, was assured the lessee for his outlay.

The Advent of the Worm Disease.

It was in 1888 that the first record was made of the occurrence in the George's River of the mud worm,* which was destined to practically exterminate the oyster from the river. In his report for the year 1888, Inspector J. D. Grant made the following observations in this connection:—"The

* *Polidora ciliata* Johnston

principal part of the oysters of George's River have been in very poor condition all through the year, very few being fit for market. The cause of this poor condition is through mud finding its way into nearly every oyster, and over this mud a very thin shell has grown. The greater part of the New Zealand oysters which were laid down in the upper beds of the river have died. Mr. T. Wray, oyster culture lessee, brought about 300 bags of spat, and Mr. J. H. Geddes about 100 bags from their areas in Port Hacking, and laid them down on their leases in George's River, out of which one-third have died from the same cause as the New Zealand oysters."

This mud was caused by the abovementioned worm, which carried it into the oyster, and the thin shell was built over the mud by the oyster in order to isolate it.

As if to make the destruction of the oyster as complete as possible, very heavy freshets occurred in the river in 1887, and lasted so long that a deposit of mud, averaging about 3 inches in thickness, was left lying on all the natural beds in the river, with the result that a large proportion of the oysters was smothered.

The total number of bags marketed in 1888 was 138, which included 100 bags from F. E. Holt's private oyster ground at Gwawley Bay.

It is worthy of record that quantities of oysters were brought from South Australia in 1885, and were laid down at Oven Reach, above Como. These developed quite successfully, and a collection of them was exhibited at the Centennial International Exhibition in Melbourne in 1888.

In 1887, 300 bags of oysters were collected from Port Hacking, and in 1888, 400 bags were transferred from the same locality to leases in George's River to develop and fatten. In this connection Inspector Grant reported as follows:—"The majority of the oysters on the north shore are poor and not marketable, and never would be if left to remain in Port Hacking, as they grow in great clusters, oyster upon oyster. The underneath ones die, and so the whole bunch falls off the rocks, and those that remain alive are buried or choked with sand, and also perish. The removal of the said oysters is the means of saving hundreds of bags during the year, and greatly improves oyster culture in George's River."

The waters of Port Hacking have always been a valuable source of supply to the lessees of George's River for, by separating the clusters, which are very prolific, and carefully laying the individual oysters on a good bottom in George's River, a commercially useless article of food is converted into a valuable asset. From the very earliest times up to the present day this transference of oysters has been extensively carried on, and splendid use was made of this scheme in order to stock returned soldiers' leases, to which further reference is made on page 25.

During 1889 the mud worm increased with alarming rapidity. All the beds from Tom Ugly's Point as far as oysters grew up the river were in a very bad state. Practically the whole of those growing in deep water were affected, and in many other parts, particularly in the higher reaches of the river, the foreshore oysters also were in a similarly bad condition.

During the whole of the year 1889 there were only four bags marketed, from which it will be seen how serious was the loss caused by the activity of this pest. In the hope of providing a remedy for the oyster worm, which was not only causing such havoc in the George's River, but also in the Hunter and Hawkesbury, the Fisheries Commissioners instructed Mr. Whitelegge, Zoologist of the Australian Museum, to make an examination with the object of ascertaining its habits and development, and to furnish a report. Whitelegge spent some time in the neighbourhood of Newcastle prosecuting his researches, which were continued and completed at the Australian Museum. On the 19th April, 1890, his report was published, and was reprinted in the "Records of the Australian Museum," Part I, pp. 41-54. This was an excellent paper and several practical remedies were suggested.

Inspector Grant, in his report for 1890, stated, "I visited all parts of the river, and found all oysters below low-water mark in a bad state with the worm disease, not one being fit for market. There were also a great many dead. All the oysters above low-water mark that I have seen are healthy and clear of the disease. The private oyster fishery of T. Wray in Gwawley Bay is mostly in good condition. There are a few infected with the disease, but these are what he removed from his oyster lease in Oven Reach over twelve months ago. Oysters on the mangrove flats at the lower parts of the river and Quilbray and Weeney Bays are healthy."

The reason the worm had not attacked the oysters in the last-mentioned localities was, in the light of our present-day knowledge, because there was nothing to which the oysters could become attached, except the mangroves and cobblers' pegs, for the bottom consisted of soft mud. In view of the fact, therefore, that the mangroves grew in the vicinity of high-tide mark and that the worm works from about mid-tide mark towards low tide and deep water, it is obvious that these oysters remained comparatively immune, owing to their advantageous situation in regard to it.

During 1890 only twenty-eight bags were despatched to market, and most of these came from Wray's private waters in Gwawley Bay.

In April, 1891, Wray, in his diving dress, tested all the deepwater beds, and found the worm disease still very bad, for nearly all the oysters were dead, and those which had survived were in a very bad state. During this year also the worm began to attack many oysters between tide marks. As stated above, the only oysters that were free from invasion were those growing on the mangroves and cobblers' pegs, and these were becoming very scarce, owing to the

fact that the public collected them as fast as they reached an edible size. Moreover, it was impossible to prevent the public from gathering them for their own consumption under section 15 of the Oyster Fisheries Act, which stated: "None of the provisions of this Act applicable to oyster-fishing shall be held to apply to any persons taking oysters when engaged in picnic parties or otherwise *bona-fide* in the pursuit of pleasure. Provided that oysters so taken by them shall not be sold or offered for sale, or dealt with in any other manner than for actual consumption on the spot where the same may be gathered."

During the ensuing few years the beds remained in the same impoverished state, and I can find no record of any oysters at all being marketed during 1891, 1892, and 1893, whilst in 1894 the total of those sent to Sydney amounted to only 12 bags, and in 1895, 27 bags.

Interest now centres on the first phase of artificial cultivation by the laying down of suitable material, or cultch, as it is called, to catch the spat, and the subsequent transference to a fattening ground. The first serious attempts in this direction date from about the year 1896. A year or two previously lessees were prevented by regulation from collecting spat off Crown lands not under lease. The result was that they were faced with one of two alternatives—either they could wait till the oysters grew naturally on the rocks contained in their leases, or they could increase their catchment area by laying out suitable material. A few of the more progressive and far-sighted lessees chose the latter course, and laid out stone, logs, or sticks as spat collectors. These men were the pioneers of oyster culture as it is carried on to-day. True, long before this time experiments had been tried by using loose stone as cultch, but such instances were very isolated, and the cultivation was carried out in a very desultory manner, so that organised artificial propagation on a commercial scale actually began about the year 1896.

The Commissioners of Fisheries, recognising the importance of this innovation to the industry, recommended to lessees in 1898 certain methods for the successful catchment of spat. These directions were as follow:— "Substances with a clean surface should be laid down just prior to the liberation of the spawn. Such substances as oyster shells, dried and bleached during the winter months, and stones recently broken, with clean surfaces, may be used. Tops of branches of oak trees, slates suspended, which have been whitewashed, or tiles covered with a specially-prepared cement, consisting of lime, sea-water and sand in variable proportions, which allows of the easy chipping off of the attached mollusc, are very suitable."

In 1898 there were 14,700 yards of foreshore under lease, and in addition 1,400 yards were applied for. All the leases were greatly improved during the year, and 878 bags were sent to market, an increase of 326 bags over the previous year.

At this time the ravages of the mud worm began to show signs of abatement. The extensive adoption of artificial cultivation gave the lessees an opportunity of carrying out the recommendations of Whitelegge, principal amongst which was the transference of oysters from between half and low tide marks to above high-water mark. Here they were left to lie protected from the sun for ten days or more, after which time the worms were found to be dead. With the advent of cut stones, logs and sticks, this course of procedure became at once practicable and effective.

The result of these precautions was that the industry began to show signs of prosperity, and in 1899, 1,365 bags of oysters were marketed. This was an increase of 476 above the previous year's output.

It is worthy of note that the average price received in 1899 for a 3-bushel bag of oysters was £1 10s. During that year there were about twenty practical oystermen employed in connection with the leases.

During the year 1900 artificial cultivation grew apace, and the following methods were extensively employed in many parts of the river, but particularly at Pelican Point, Carter's Island, Towra, and at the western entrance to Oatley Bay :—

1. Rows of cut stones, roughly 2 ft. x 1 ft. x 4 in., laid from high-water to low-water mark.
2. Stones laid in rows about 2 feet high and 3 feet wide from high-water down to and below low-water mark.
3. Stout oak or honeysuckle logs laid on the soft mud flats as a foundation, upon which stones were laid.
4. Oak stakes stuck into the mud in rows as spat collectors.

All oysters about low-water mark, if allowed to remain there, still became badly affected with the worm.

During 1901 F. Selmon constructed and laid log platforms which were used as beds for the maturing of young oysters. In the same year, W. E. Smith constructed for the first time shell maturing beds at Carter's Island. Similar beds are illustrated on page 50, and a detailed description of their construction is given on page 48. These were an immediate success, the oysters developing rapidly and showing little signs of worm infection.

The gathering of oysters by the public on the foreshores for their own consumption, particularly off the mangroves and cobblers' pegs, kept those places so bare that, on 20th August, 1902, a proclamation was issued prohibiting the taking of oysters from George's River by the public for a period of three years from that date.

During 1902, also, an Act of Parliament was passed to further regulate the fishing and oyster industries. The most important clause of this Act, so far as it affected the oyster industry, was that which provided that " Every

lessee shall cultivate his leased area by laying down below high-water mark sufficient quantity of clean, hard substances, such as stones, shells, stakes, shingles, tiles, logs, or other like material for catching spat, within twelve months of the issue of the lease, and any person failing to take proper steps to cultivate such leased area, shall be liable to have it cancelled."

This provision had the effect of stimulating the more negligent lessees to improve their leases, in order to obviate the risk of forfeiture.

During 1902 the worm disease became restricted to certain parts of the river. It was prevalent only in the upper reaches and in Towra and Quibray Bay, where the leases had from 2 to 3 inches of water lying on the greater portion of them at low tide. The lessees were, however, fighting hard to combat the pest by keeping the oysters well above low-water mark.

In 1903, 4,000 oak shingles, about 2 ft. 6 in. in length, were laid out in Quibray Bay. These were placed in the mud in a slanting position at about half-tide mark, when the oysters were expected to spawn, and on their under surfaces the spat attached freely. In the following year they were transferred to low-water mark, and their position taken by a fresh batch. In the third year the shingles from low-water mark were transferred into deeper water, where they were permanently submerged. At the end of the third year the wood was usually riddled with cobra, and the oysters, now fully grown, were readily detached. The same operations of transferring to deeper water were then continued in rotation.

Cultivation by shingles, though successful as a means of catching the spat and raising it for market, proved costly because of the fact that, after the third year, the wood was rendered unfit for further use by the cobra, and therefore, after a few years' trial this method was abandoned.

During 1904 the artificial cultivation of oysters grew apace. Great numbers of . tones were laid at all angles, several leases were covered with shell maturing beds, raised from 6 inches to a foot above the natural bottom, whilst others were improved with logs, slabs and shingles. In Quibray Bay slates were laid on logs. In fact, any material at all suitable to the catchment of spat was used by the more enterprising lessees. In addition, large quantities of small, stunted oysters were transferred from other rivers, particularly Port Hacking and Cowan (Hawkesbury River). Many lessees cut great numbers of drains out to low-water mark. By so doing the development of the mud worm was largely frustrated. So diligently had the men worked to combat the worm that, at this time, there were very few oysters to be found infected. There was, in fact, less worm disease than had been known for ten or twelve years previously.

There were thirty men employed in the industry in 1904, and 21,960 yards of frontage were under lease.

The worm disease continued to decline during 1905, and the warfare waged against it during the past few years was sustained with unabated vigour. Those lessees whose ground consisted of a big stretch of low-lying mud continued to dig drains, some of which were from 500 to 600 yards in length. The firmer material taken from these drains, consisting of grit, shells, &c., was used to build up maturing beds, which varied in size from 4 perches to half an acre.

After experimenting with practically every material available for the catchment of spat, the lessees reported that tiles and slates proved to be superior as cultch to any other substance.

The year 1906 was an epoch-making one in the oyster industry, not only of George's River, but also of the whole State. Previous to that year the average price realised by the lessees for a 3-bushel bag of oysters was £1 10s. This low price was maintained chiefly by reason of the fact that their distribution was in the hands of a monopoly. During 1906, however, a rival company came into the field, and the market price was increased to as much as £3 per bag. At last the lessees began to receive encouragement in the form of cash to compensate them for the hard work that had been expended, and for the many disappointments caused by disease and adverse conditions. The immediate result was a decided stimulus to oyster culture, which was developed on a more intensive scale than ever before.

This increased return and the regulation of 1902, making it imperative for lessees to cultivate their leases or forfeit them, were, I consider, the two most important factors contributing to the development of the oyster industry on the coast of New South Wales during the whole of its existence.

Bell weed, silky weed, and broad weed, growing on the mangrove flat leases, caused considerable trouble at this period.* It became necessary for the lessees to devote a certain amount of time periodically to the raking or hand picking of these plants and throwing them into heaps to decay.

The worm disease continued to decrease, and in 1906 there was very little of it to be found anywhere along the river.

On one lease, at the eastern entrance to Kyle Bay, on 300 yards of foreshore, there were over 800 tons of stone slabs laid out in all positions in 1906, and in the following year the catch of young oysters averaged about two dozen to each stone. During 1907 there were about 3,000 slabs laid out at Shell Point in Woollooware Bay and on the foreshore between there and Commons Point.

The lessees continued to take precautions against the mud worm by building firm maturing beds out of grit and dead shell, thereby eliminating to a very large extent the mud which harboured it.

* Bell weed is a true seaweed (*Hormosira banksii*), whilst those known locally as broad weed (*Posidonia australis*) and silky weed (*Zostera* sp.) are really marine submerged flowering plants.

During 1908 increased activity was shown in the transposition of undersized oysters from Port Hacking, several lessees having been granted permits to remove up to 200 bags, of which full advantage was taken.

The total length of foreshore under lease in 1908 was 30,513 yards, and there were also $5\frac{1}{2}$ acres of deepwater beds.

In order to illustrate the great decline in the prevalence of the mud worm at this time, the experiences of lessees with deepwater beds may be cited. During 1905 a quantity of young oysters was laid down on two such beds at Oven Reach and O'Connell's Bay. These were collected during 1908 by a diver and were found to be in excellent condition, and perfectly free from the worm. Five years previously these areas were so infested that cultivation was impossible. Occasionally a few oysters would be found with the worm on the soft mangrove leases where a few inches of water covered them at low tide, and also on the rocky foreshore leases at low-water mark, but taking the river as a whole, it could be said that, in 1908, this pest was causing no material damage.

A great quantity of spat was again collected at Port Hacking during 1909 and transferred to deep-water beds in George's River. If these beds continued free from the worm, the lessees were determined to stock them to their utmost capacity, not only because the bottom was naturally a firm one and required no improvement or attention, but also because the oysters developed more quickly, and attained a greater size and more healthy condition than those grown to maturity on the foreshores.

Continued activity was manifested also in the laying down of stone. On two leases alone in Woollooware Bay—south-east of Pelican Point—40,000 stone slabs were distributed in the course of the year.

The turbellarian worm known as the "wafer"* was reported to be causing a good deal of trouble at this time, particularly on the shell maturing beds and on the mangrove leases. The lessees, immediately upon its discovery, took prompt steps to combat it by going regularly over their leases and carefully gathering those that could be found.

The boring mollusc, known as the common borer,† was also found in increasing numbers, though, strange to say, little damage was reported to have been caused by it. In fact, it was very rarely that a bored shell was found.

All the deepwater beds, which at this time had increased to seven, continued to be free from the mud worm.

The number of men employed working the leases during 1909 averaged about 50, with 30 boats, 20 punts, and 2 launches.

* This worm appears to be an unidentified species, though Mr. R. Bretnall, of the Australian Museum, informs me that it is possibly identical with *Leptoplana australis*.

† *Xymene hanleyi*, Angus.

At this period the cultivation of the oyster on George's River was advancing by leaps and bounds, due to the progressive policy adopted by the principal lessees. When it was recognised that the various pests had been practically overcome, the future prospects of the industry appeared in a brighter light than was ever the case hitherto, and the lessees did not hesitate to invest the whole of their earnings in the future development of their cultivations. The result was that whilst the output for the year 1909 was 923 bags, that for 1910 was 1,456, and in 1911 the total reached the very satisfactory figure of 2,248 bags. No better proof than these figures can be given as an illustration of the initiative of the lessees and the healthy conditions obtaining in the river.

Notwithstanding this increased output, the lessees were not entirely free from worry, for the deep-water beds again developed the worm disease in 1911, when fully 40 per cent. of the oysters were affected by it, and in 1912 they were again practically wiped out. Hundreds of bags of spat had been distributed over them three years previously, fully 90 per cent. of which had now succumbed, whilst those which had survived were so badly infected as to be worthless. Fortunately, these deepwater beds had become, by this time, a mere side issue to the main industry, and whilst much disappointment was caused by the recrudescence of the worm in these localities, still the foreshore leases, the backbone of the industry, were affected to only a small extent. It was, therefore, decided to concentrate entirely on the latter, and to eliminate for good the deepwater beds as cultivation areas.

The wafer continued to give a certain amount of trouble, but owing to the attention paid to it, was rapidly diminishing in numbers. The borer was still fairly plentiful, but apparently caused little damage.

Continued freshets in 1913 were the cause of considerable anxiety and labour on account of the quantity of silt which was deposited on the beds, particularly on those situated above Como. Large quantities of mature oysters and much spat were killed, and many lessees were forced to lift the oysters and clear away the mud. When the freshets had subsided, and the density of the water once again assumed its normal state, it was found that, although a percentage of oysters had been killed as a direct result, still, in the aggregate, the fresh water proved to be decidedly beneficial, for very few wafers or borers were subsequently observed, the endurance of the oyster in fresh water being greater than that of either of these pests.

The enthusiasm of the lessees in the development of their leases was sustained during 1914 and 1915, when conditions were again entirely favourable to oyster culture, the stone slabs easily outdistancing any other material, though much timber was also used.

During 1916 another setback of considerable importance occurred in the nature of a heavy mortality caused by a succession of very severe frosts. The loss from this cause was greatest on the mangrove leases, where the bottom is

flat and the surrounding country low-lying. The mortality was greatest when there were big ebb tides in the early hours of the morning. The water of the incoming tide, rising slowly over the mud flats and dissolving patches of ice in every pool, became so lowered in temperature that the oysters, in many cases, failed to withstand the sudden shock. When the frosts occurred on three or four successive nights the damage done was particularly heavy. Hundreds of bags were lost in this manner during August of that year.

Further severe losses were also caused in the same manner during 1917 and 1918, when the winters were again very severe.

A bright page was reached in the history of oyster culture in the George's River during 1917, when it was decided to place as many returned soldiers as possible in the industry. When leases were found for returned soldiers, the lessees immediately formed working bees and collected immature and stunted oysters from the foreshores of Port Hacking. Permission was received from the Fisheries Department to take whatever oysters were required from Crown lands free of charge, and several private lessees also approved of their removal. The Department paid the expenses of carting the oysters to George's River and of towing them to the leases. The lessees then assisted the returned men to lay their oysters on beds and freely gave practical advice as to their further care and the improvement of the leases. Many hundreds of bags were collected by this means, and a large quantity was also sent to the Manning River for the same purpose.

The same procedure was adopted during the following years, 1918 and 1919, and during the latter 940 bags of spat were laid out on returned soldiers' leases.

Too much praise cannot be bestowed upon the lessees of George's River for this thoughtful action, which called for a great deal of self-sacrifice and hard work. The time and labour were given voluntarily, which exhibited a spirit of thoughtful co-operation, and merits our very highest admiration.

During 1917, 1918 and 1919 the worm, wafer and borer were more or less in evidence, but did not materially affect the prosperity of the industry.

The following tabulated list will serve to show the resources of the industry on the George's River during the years 1917-1919, inclusive. The decrease in output of 1,101 bags in 1919 is directly attributed to the loss caused by the frosts of the three preceding winters.

Year.	Men Employed.	Launches.	Boats.	Punts.	Value of Launches, Boats, and Punts.	Output in Bags.
1917 ...	44	6	47	...	£ 1,565	2,861
1918 ...	54	6	35	18	1,921	3,247
1919 ...	58	12	41	22	2,490	2,146

That the oyster industry of George's River is in a very prosperous condition, the annual output for the past few years convincingly demonstrates. I have tried to show in the preceding pages the gradual development from the natural condition of the river, when the annual output varied from nothing to a few hundred bags to the intense cultivation which exists on the river to-day. By reading through this bare record of fact, one can estimate the struggles against adversity which have taken place as obstacle after obstacle was encountered to be overcome only by perseverance and determination until each, in turn, was subdued. One can estimate the spirit of optimism which has been displayed as each year the earnings of the previous one have been expended in cultivation, until now the leases, or many of them, are very valuable, the industry is flourishing, and the lessees are making good money.

2. Methods of Cultivation.

Cultivation on Stone.

CULTIVATION on stone was the earliest method adopted by the oystermen of George's River, and at the present time is the most important, for there is far and away more stone laid out than any other material. The reason for its popularity is due primarily to its lasting qualities, for it withstands culling* without deterioration, and therefore, having borne one crop of oysters, it is just as sound as when first laid down.



Photo by]

[the Author.

FIG. 3.—A QUARRY AT KYLE BAY, THE STONE FROM WHICH IS USED SOLELY FOR OYSTER CULTIVATION. IT IS ESTIMATED THAT THERE HAVE BEEN UPWARDS OF HALF A MILLION SLABS TAKEN FROM THIS QUARRY ALONE.

The stone is obtained either on the lease itself, should this happen to be a rocky foreshore, or, in the case of mangrove and other flat leases, from quarries, several of which are owned by the lessees. The principal of these (Fig. 3) are situated at Kyle Bay, a distance of about 3 miles from the mouth

* By the term, "culling" is meant the removal of the oysters from the substance to which they are attached when collecting them for market. The implement used for this purpose is usually in the form of an iron bar about a foot long, slightly tapered at one end and brought to a blunt edge. With this the oysters are either wedged off or gently tapped at their bases of attachment.

of the river. The sandstone which occurs there is of good quality and cleaves readily. Those lessees who do not own a quarry obtain stone from private land, principally in Kogarah and Coronation Bays. The average rate paid as royalty to the owners of the land is £1 per 1,000 slabs. These are cut for the lessees by contract quarrymen, at a cost of about £6 per 1,000. The slabs are towed on punts by means of launches, and are dumped on the leases at a cost of approximately £2 per 1,000.

In the case of the rocky foreshore leases, the lessees themselves frequently cut the slabs from boulders and outcrops, or at times employ labour for that purpose. Years ago the slabs were cut of fairly large size and rectangular shape, being as much as 4 feet long and 2 feet wide, with a depth of about 6 inches, but it soon became apparent that, for purposes of transportation, this size was too bulky, and it was accordingly reduced to about 2 feet by 1 foot by 4 inches, and whilst many variations occur both in shape and size, these are on the whole the standard dimensions of the stone used at the present time.

The method of laying out the stone varies somewhat, though the bulk of it is placed in pairs on the mud, one leaning against the other, the long edges being upright. This is clearly shown in Fig. 4, which is a photograph of portion of W. E. Smith's leases (7,185) at Pelican Point. On these leases it has been estimated that there are upwards of 400,000 stones laid out. Those shown in the foreground of the photograph, which are at extreme low-tide mark, are new work, which accounts for the absence of attached oysters, whilst those in the background are mostly of older cultivation, and have borne some remarkably fine crop. The stones are laid in rows sufficiently wide apart to allow a man to pass freely between them when going over the leases, similar, in fact, on a small scale to rows of trees in an orchard. Here and there also wider channels are left, traversing the leases between tide marks, to allow a boat to pass up and down. In the photograph (Fig. 4) these rows and channels are not clearly seen, owing to the angle at which the view was taken. The whole of these stones were quarried at Kyle Bay, and towed by launch to Pelican Point, a distance of about 3 miles.

The bottom here is soft mud, into which the stones sink to a depth of 3 or 4 inches, which portion is, of course, lost as far as the catchment of oysters is concerned. The reason the stones are laid at an angle to the vertical is to present an upper and an under surface, for the spat attaches far more readily to the latter than the former. The principal set is obtained in the autumn, and the stones are allowed to remain undisturbed until early spring, when the surfaces are reversed in order to allow the young oysters to become gradually acclimatised to the approaching warmer weather. Were the thin-shelled spat suddenly exposed to the sun during the summer months, a large proportion would succumb to the heat. The under surfaces then await the December spat and that of the autumn of the following year. By this means the whole area of the stones is fully utilised.

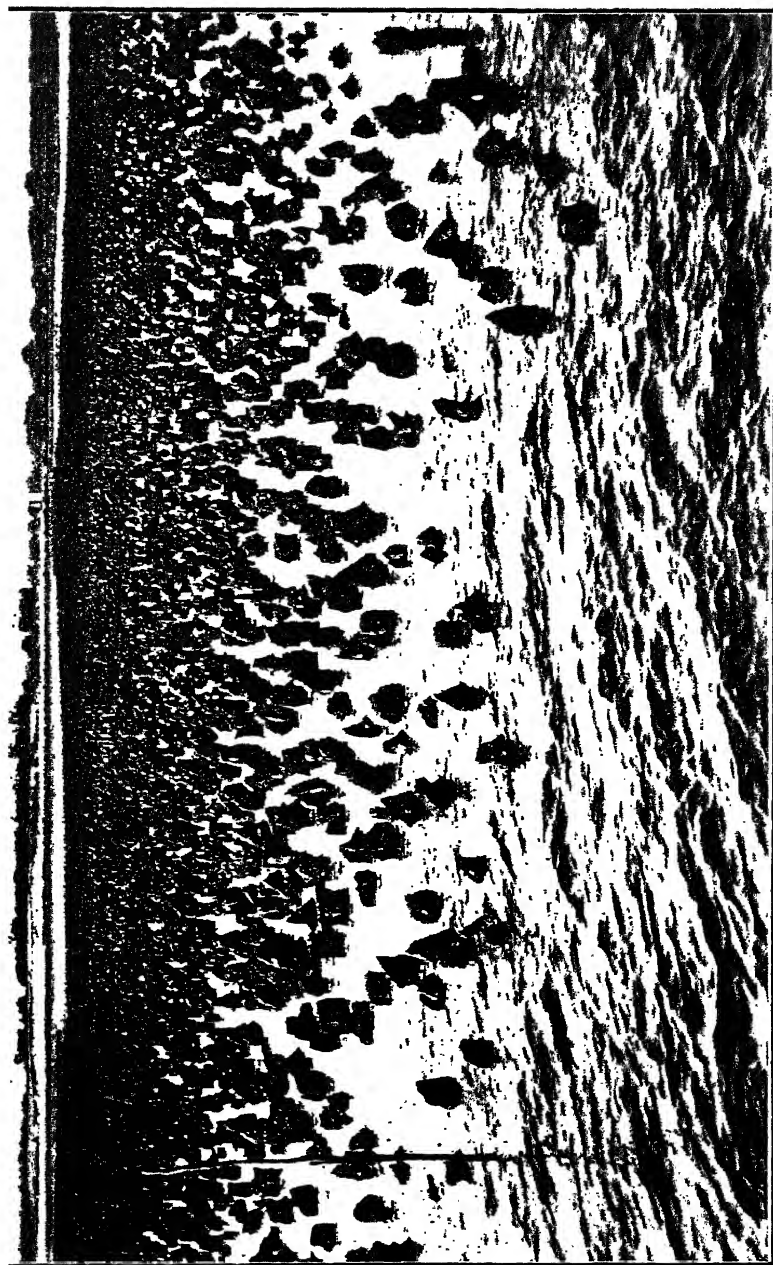


Photo. by]

FIG. 4.—RECENT STONE CULTIVATION AT PELICAN POINT.

[the Author.



Photo by *the Author.*
FIG. 5.—STONE CULTIVATION, FIFTEEN YEARS OLD, AT SHELL POINT, WOOLLOOWARE BAY.

An older cultivation may be seen in Fig. 5, which shows portion of F. Selmon's leases (7,963) at Shell Point, Woollooware Bay. These stones were laid down about 15 years ago, and are of larger size than those favoured at the present time. They were quarried at Kogarah Bay, and transported to Shell Point by punt. There has been no preliminary preparation of the bottom, which consists of soft mud. The stones extend from low tide to near high-tide mark, and their arrangement into rows is clearly seen. Just previous to the taking of this photograph the whole bed had been worked over carefully and the marketable oysters had been removed, hence the scattered appearance of the remainder; but in the past this bed has borne some very large crops for which it is noted. The area covered by it is about 4 acres.

A somewhat more elaborate method of stone cultivation is illustrated in Fig. 6. In this case the bottom, which originally consisted of soft mud uniformly distributed over the flat, has been prepared as follows: The area of the proposed bed is mapped out with pegs and round this a channel is dug through the mud to a depth of from 1 to 2 feet, when a layer of firmer material, consisting mostly of shell grit and sand, is encountered. This is thrown on to the projected bed till its height has been raised about a foot above the normal. It is then allowed to settle and swamp oak* and white honeysuckle† poles are laid transversely across it about 2 feet apart throughout its whole length. Similar poles are then laid lengthwise on these at an average distance from each other of about 18 inches. These then form the bed upon which the stones are laid. Not only stone slabs are used, but also rock broken up into irregular pieces and any other material that may be available, such, for instance, as broken tiles and scrap iron.‡ The raised timber supporting the stones not only keeps the latter from contact with the bottom, but also allows a free circulation of water beneath them. Oysters so situated are less susceptible to the depredations of the mud worm, borer and wafer, and, moreover, the whole area of the stone is available for the catchment of spat. The beds vary in length from 50 to 100 feet, and average about 6 feet in width, with a similar distance between them.

This method of cultivation has proved very effective, and is a decided improvement on those illustrated in Figs. 4 and 5. The extra labour involved in the preparation of the bed and the additional cost of the timber are the only factors which weigh against its more extensive adoption.

A variation of this last-mentioned cultivation is seen in Fig. 7, which shows portion of Andrew Derwent's leases at Neverfail Bay, near Como. In this case the beds are arranged in long narrow rows at right angles to the bank, and extend from about a quarter to three-quarter flood tide. Here the bottom has

* *Casuarina glauca*, Sieb.

† *Banksia integrifolia*, Linn.

‡ There is a fairly prevalent impression that oysters grown on iron or wood are not fit to eat. This is quite erroneous, for neither in any way affects the oysters detrimentally.



Photo by] FIG. 6.—STONES AND TILES LAID ON A BUILT-UP MATURING BED, WOOLLOOWARE BAY. The Author.



Photo by] FIG. 7.—NARROW STONE CULTIVATION, AT NEVERFALL BAY, NEAR COMO. The Author.

received no special preparation. Fairly stout oak logs from 2 to 3 feet in length are laid at right angles to the direction of the bed at a distance apart of about 4 feet throughout its whole length. Across these are placed a parallel row of oak poles about 18 inches apart, and extending from end to end of the cultivation. This framework is used for the purpose of supporting the stones and keeping them clear of the mud. The arrangement of these stones is worthy of note, for they are not laid flat on the wood, but slightly overlap, the edge of each resting on that of the one preceding it, thus :—



FIG. 8.—THE ARRANGEMENT OF THE STONES SHOWN IN FIG. 7.

By this means a free circulation of water is secured, and practically the whole of the surface is available for the catchment of spat. The stones are turned over in the Spring, and are then allowed to remain until the oysters mature, usually at the end of about 3 years. This method of overlapping the stones is exactly similar to that used in France in the middle of last century.

A small bed of different shape and somewhat different construction is shown in Fig. 9. This type is used in considerable numbers at Carter's Island, and serves not only for the catchment of spat, but also as a maturing bed. The bottom here is soft mud, into which one sinks about a foot when walking over it barefooted. This bed is constructed as follows: Two split oak or honeysuckle logs about 5 feet in length are laid on the mud parallel to each other and about 4 feet apart. Across these are laid close together other split logs of the same length, the number varying from eight to ten. Upon this platform the stones are arranged. The weight of the whole soon causes it to partially settle into the mud, and the two logs forming the base become lost to view. The platform remains on the surface and frequently catches a good crop of spat. The dimensions of this bed are 5 feet square.

Fig. 9 illustrates such a bed partially constructed and clearly shows its arrangement.

The photographs so far illustrating this article have been taken on flat leases, where the area of bottom uncovered at low tide is very extensive, and whilst there is quite a considerable length of foreshore of this nature, by far the bulk of George's River is lined by narrow foreshores, where the distance between high and low tide does not average more than 50 feet. On oyster leases so situated there is not the scope for the variety of methods that the flat leases offer, consequently, cultivation is confined practically to the laying of the stone on the mud.

The photograph reproduced in Fig. 10 was taken at Kangaroo Point, and is typical of such cultivation. Here the stones are cut on the lease between



Photo by]

FIG. 9.—BED OF STONES ON SPLIT LOGS, UNDER CONSTRUCTION, CARTER'S ISLAND.
[the Author.

tide marks, and many can be seen in the illustration stacked ready for use. Their arrangement differs slightly from those shown in Figs. 4 and 5. In this case a slab is stuck into the mud vertically, and two others, one on each side, rest against it at an angle of about 45 degrees.

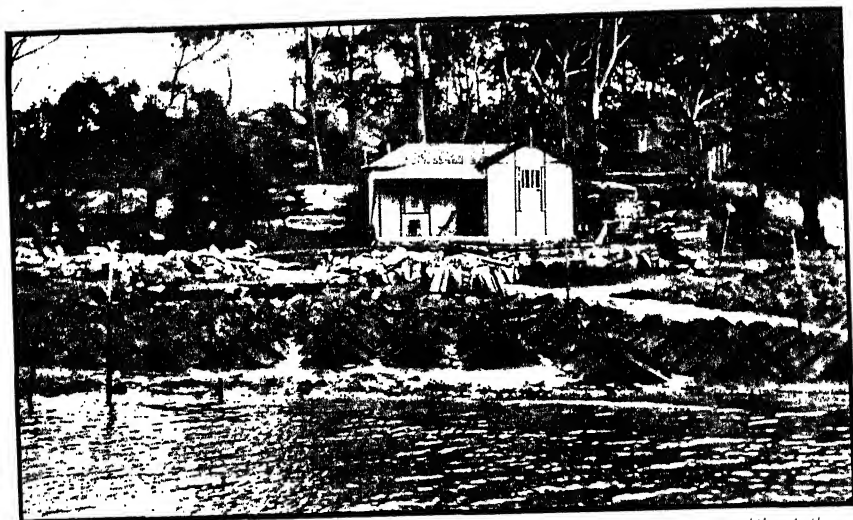


Photo by]

[the Author.

FIG. 10.—STONE CULTIVATION ON A TYPICAL NARROW FORESHORE LEASE, KANGAROO POINT.

Cultivation on Wood.

Whilst the cultivation of oysters on wood in the George's River is of secondary importance when compared with that on stone, nevertheless there are a few leases, particularly near the mouth of the river, where large areas have been extensively developed by this means.

The great advantage of stone over wood is that the former is practically everlasting in the water, whilst the life of the latter is limited. Moreover, there are very few species of our timbers which will last for more than a very few years when submerged, though, fortunately, two or three of the more durable grow in close proximity to our rivers. Those trees which experience has taught are of greatest value for oyster culture are the swamp oak, the white honeysuckle and the black mangrove.* Swamp oak trunks will last for upwards of twenty years in the water, white honeysuckle about ten, whilst the black mangrove varies greatly, the limit of its life being about six years.

At Towra, on the eastern bank of George's River, near its entrance to Botany Bay, large quantities of oak and honeysuckle are growing naturally,

* *Ægiceras majus*, Gaertn.

and it is from here that the lessees obtain their supplies. The black mangrove is found scattered along the banks of the saltwater portions of the river, and must not be confused with the grey or white mangrove* which grows in similar situations, but which is useless for oyster culture. They are easily distinguished, the black being a tree of stunted growth with leaves of a dark-green colour, whilst the grey grows into a moderately large tree with lighter coloured leaves and bark.

There are three or four different methods of cultivating oysters by means of wood, that shown in the foreground of Fig. 11 being the simplest. This photograph illustrates portion of E. D. Cooper's leases (6,299 and 9,411), situated on the eastern shore of Towra (Botany Bay), near the mouth of the George's River. It shows a forest of swamp oak and white honeysuckle saplings arranged in two different manners. In the foreground and distance they are driven into the mud singly and upright to a distance of from 12 to 18



Photo by]

[the Author.

FIG. 11.—A FOREST OF OAK AND HONEYSUCKLE SAPLINGS AT TOWRA.

inches. Their average height is about 3 feet, and, with the exception of those situated near high-tide mark, are wholly covered by water at high tide. In the middle distance the poles are arranged as follows: Forked uprights are driven into the mud and horizontal poles, 6 to 8 feet long, are laid in the forks, which are at an average distance from the bottom of about 12 inches. This timber is laid out when green, and consequently remains submerged at high tide.

The cultivation here illustrated extends from low tide to near high tide mark, and covers an area of about 5 acres. Most of it is new work, which accounts for the absence of attached oysters in the photograph, which was taken in April, 1921.

* *Avicennia officinalis*, Linn.

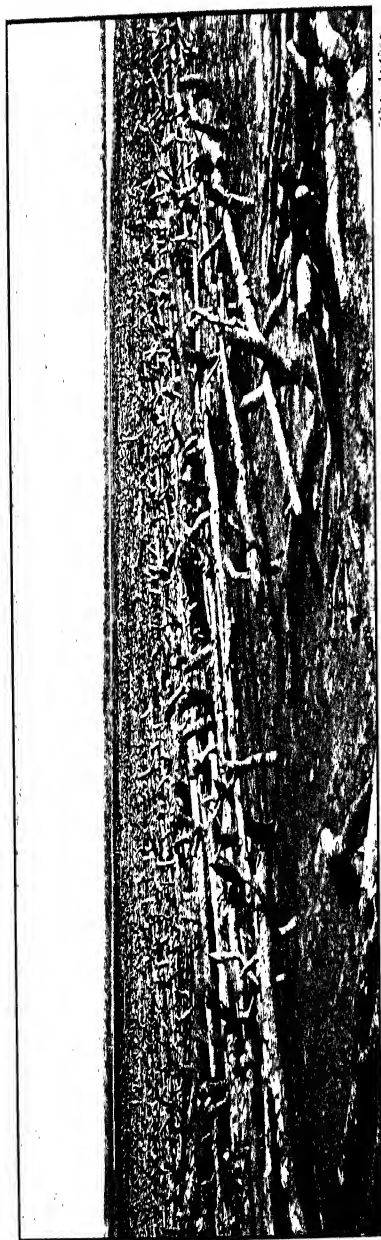


Photo 65.

FIG. 12.—CULTIVATION WITH FORKED POLES AT CARTER'S ISLAND.

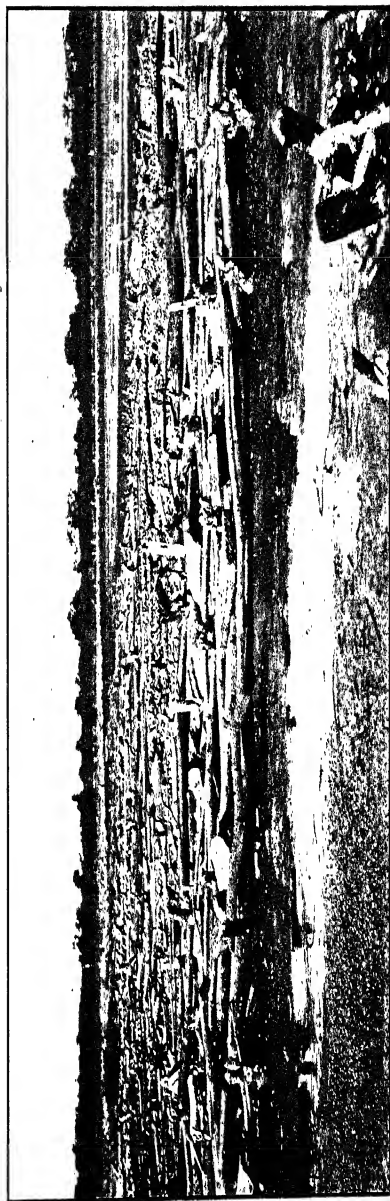
The Author.

Photo 67.

FIG. 13.—TIMBER CULTIVATION WHICH ALSO SERVES AS A PLATFORM FOR STONES AT TOWRA.

The Author.

An extensive area of forked pole cultivation is illustrated in Fig. 12, which shows one of W. E. Smith's leases at Carter's Island, near the mouth of the river. This is older work than that illustrated in Fig. 11, and, although the timber in the foreground has a poor crop, some portions of the lease are thickly covered with very fine oysters. This bed extends from low-water mark to about half-tide. The horizontal poles are not secured to the forked uprights in any way, their own weight being sufficient to keep them in place when the water rises over them. They are, of course, completely submerged at high tide.

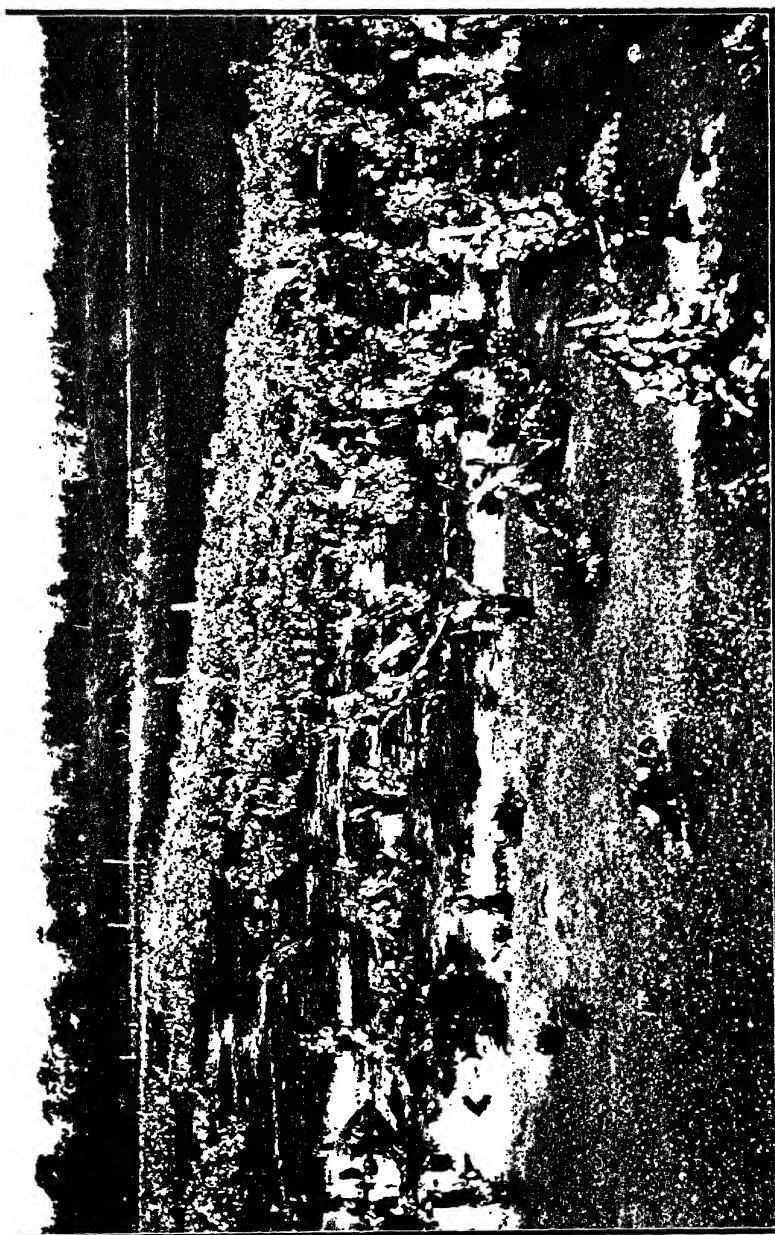
A similar arrangement of forked poles is illustrated in Fig. 13, but here they are placed very much closer together, and not only serve as spat-catching surfaces, but are also used as a platform upon which to place stones. This cultivation is part of Major Lamb's lease (7,409) at Towra, near the mouth of George's River, and is situated about midway between tide marks.

In order to demonstrate the extent to which wood used in this manner is capable of sustaining a large crop of oysters, Fig. 14 is reproduced. This shows portion of J. S. Smith's lease (2,418), also situated at Towra. The wood here has been in use for many years, and has produced many heavy crops. When this photograph was taken, practically the whole of the available area of the timber was covered with good marketable oysters, in spite of the fact that it was showing marked signs of decay. Oak and honeysuckle are the timbers employed here, the former largely predominating.

A method of cultivation which was used to a greater extent in the past than at the present time is that illustrated in Fig. 15. This consists simply of split stakes driven into the mud at an angle, in order to present an under surface for the catchment of spat. They project about 18 inches above the mud, and are stuck into it about a foot deep. This is not considered to be a very economical method of utilising the wood, and for this reason has been gradually superseded until, at the present time, the bed here illustrated is the only one remaining on the river. It is the work of W. E. Smith at Carter's Island.

Small branches and twigs of oak, honeysuckle and black mangrove have been used with remarkably successful results in Gwawley Bay. A typical bed of this nature is shown in Fig. 16. Here the branches have all been laid across an old shell improving bed, which has been raised above the surrounding mud. This material was placed in position about three years ago in order to catch the spat, and has been allowed to remain there whilst the oysters developed. A very fine and healthy crop indeed has resulted.

There are many advantages in this method of culture, amongst them being (1) the cheapness of the material which, when the trees are chopped down, is usually allowed to waste; (2) the free circulation of water all round the oysters; (3) the portability of the branches with their attached oysters, and (4) the facility with which the mature oysters are removed when culling.



[The Author.]

FIG. 14.—VERY OLD STAKE CULTIVATION WITH A HEAVY CROP, AT TOWRA.

Photo by]

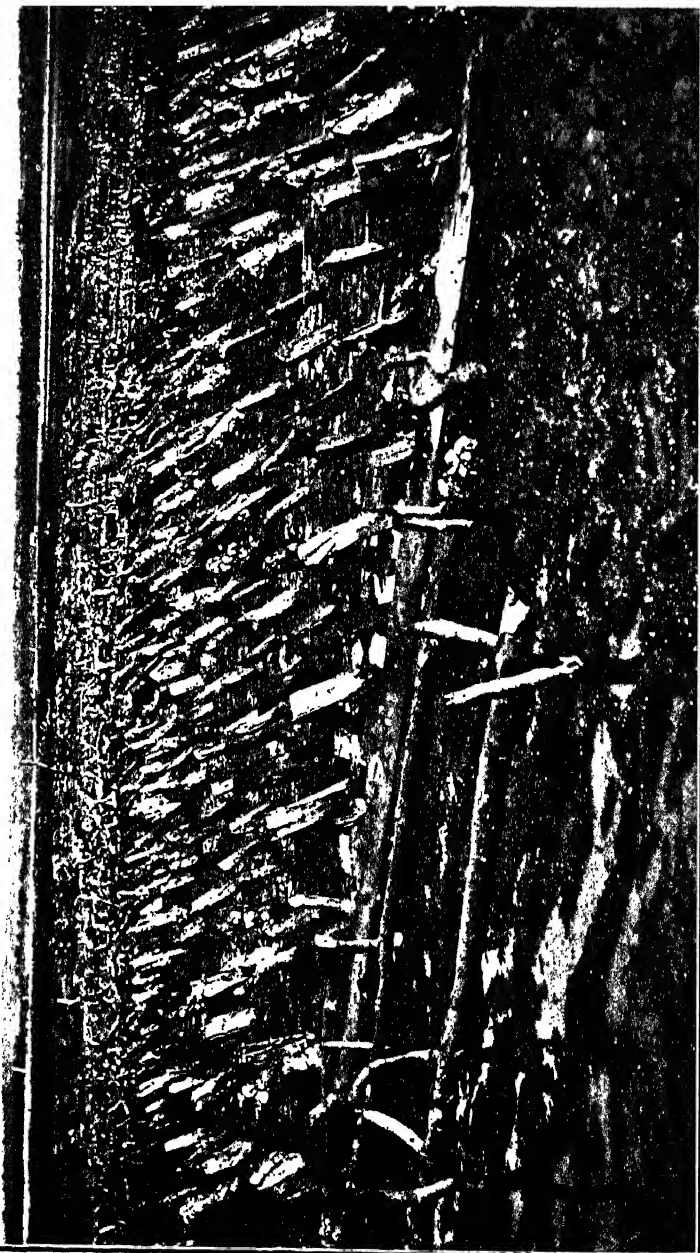


Photo by.

FIG. 15.—BED OF SPLIT STAKES, CARTER'S ISLAND.

The Author.

Rocks laid in pairs may also be noted in the foreground, whilst the channels surrounding the bed are clearly shown.

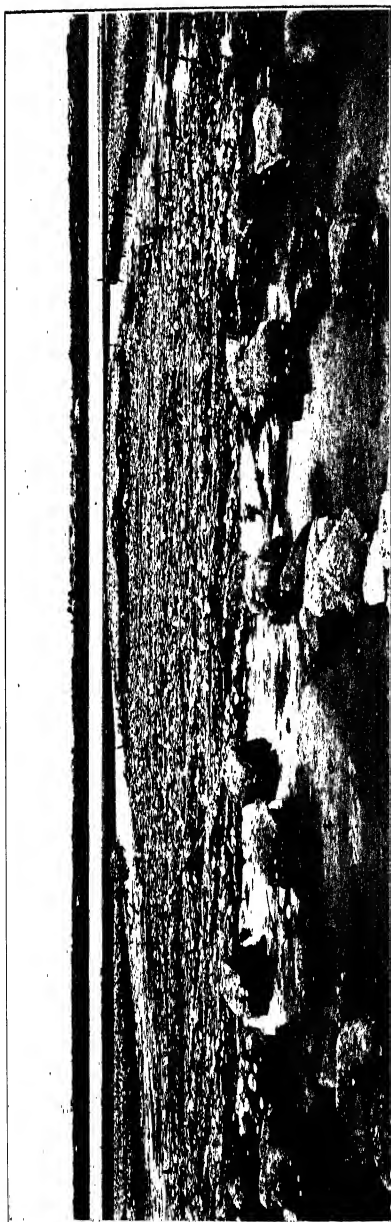
The dimensions of this bed are 50 feet by 33 feet, and it is situated at about a third flood tide measured from low-tide mark. It forms portion of J. S. Smith's leases in Gwawley Bay, west of Sandy Point.

Cultivation with Tiles, Slates and Fibro-Cement Sheets.

Oyster cultivation on slates and tiles dates back about fifteen years in the history of George's River, and whilst, as surfaces for the attachment of spat, they have proved to be extremely satisfactory, still, for several reasons, they have not been adopted on a very large scale. The principal of these is their cost which, for some years, has been so extremely high that the additional outlay required as compared with stone or wood is not compensated for by the increased production of oysters per square foot of surface. Those that are at present in use on the river were purchased years ago, and a proportion of them was acquired considerably under the market prices ruling at that time, owing to defects which caused them to be condemned for roofing purposes. Then, again, they are more or less fragile, and a percentage is broken annually when removing the oysters for market. In the hands of an experienced lessee, the breakages average only about 5 per cent., but in the hands of the novice they may rise as high as 20 per cent. These are not a dead loss, however, for the broken pieces are placed on other beds (see Fig. 6), along with stone, &c., to await a further catchment of spat.

Fibro-cement sheets are of more recent introduction, and whilst their cost is less than either of the above, they are still more fragile, and, for this reason principally, have not come into more general use.

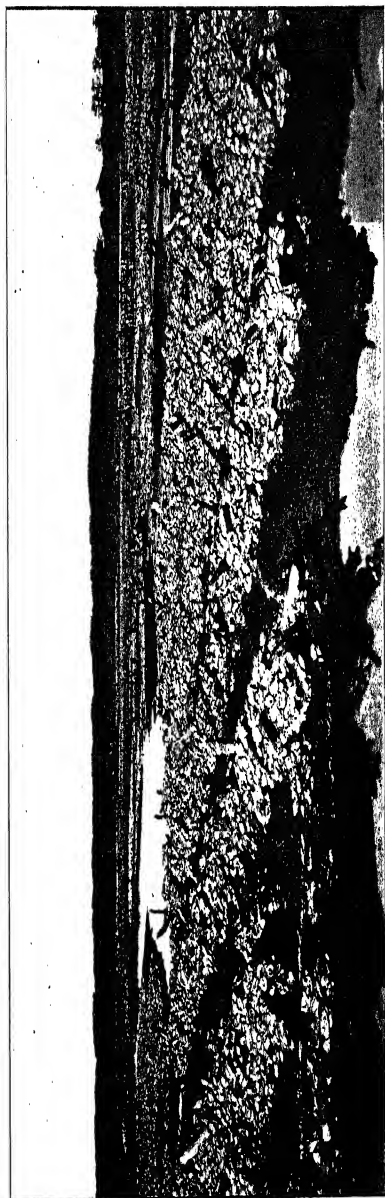
In practice there are several different methods employed in the use of these materials, one of the most successful being that illustrated in Fig. 17. This is a cultivation consisting of flat tiles, and is situated at Carter's Island, at present under lease to W. E. Smith. Their arrangement is as follows: Horizontal poles of swamp oak are laid between forked uprights of the same timber at a distance of about a foot above the bottom, which consists of soft mud. The tiles, which are 18 inches long, 12 inches wide, and $\frac{3}{4}$ inch thick, rest against these poles in rows on each side, the long edge upright, and the lower edge resting on the mud. They were specially made for oyster work about fifteen years ago, and cost, delivered at Sandringham, £4 10s. per thousand. From there they were towed to the leases, a distance of about a mile. The bed illustrated extends from low tide mark to about quarter flood tide, in which situation the oysters mature most rapidly.



The Author.

FIG. 16.—BUSHES AND STICKS LAID ACROSS A MATURING BED, GWANALEY BAY.

Photo by]



The Author.
FIG. 17.—FLAT TILES ARRANGED IN ROWS, SHOWING AN EXCELLENT CROP OF MATURE OYSTERS, CARTER'S ISLAND.

Photo by]

A glance at the photograph shows what a heavy and uniform catch has been obtained, and this is but one of many such crops that these tiles have produced.

Another method of utilising tiles is shown in Fig. 18. This cultivation is on one of F. Selmon's leases (9, 194) in Woollooware Bay, south-east of Shell Point. The elevated bed is constructed in a similar manner to that described on page 31. On this foundation poles are laid end to end throughout its length, about 2 feet apart, and across these is placed sawn hardwood timber, with a



Photo by

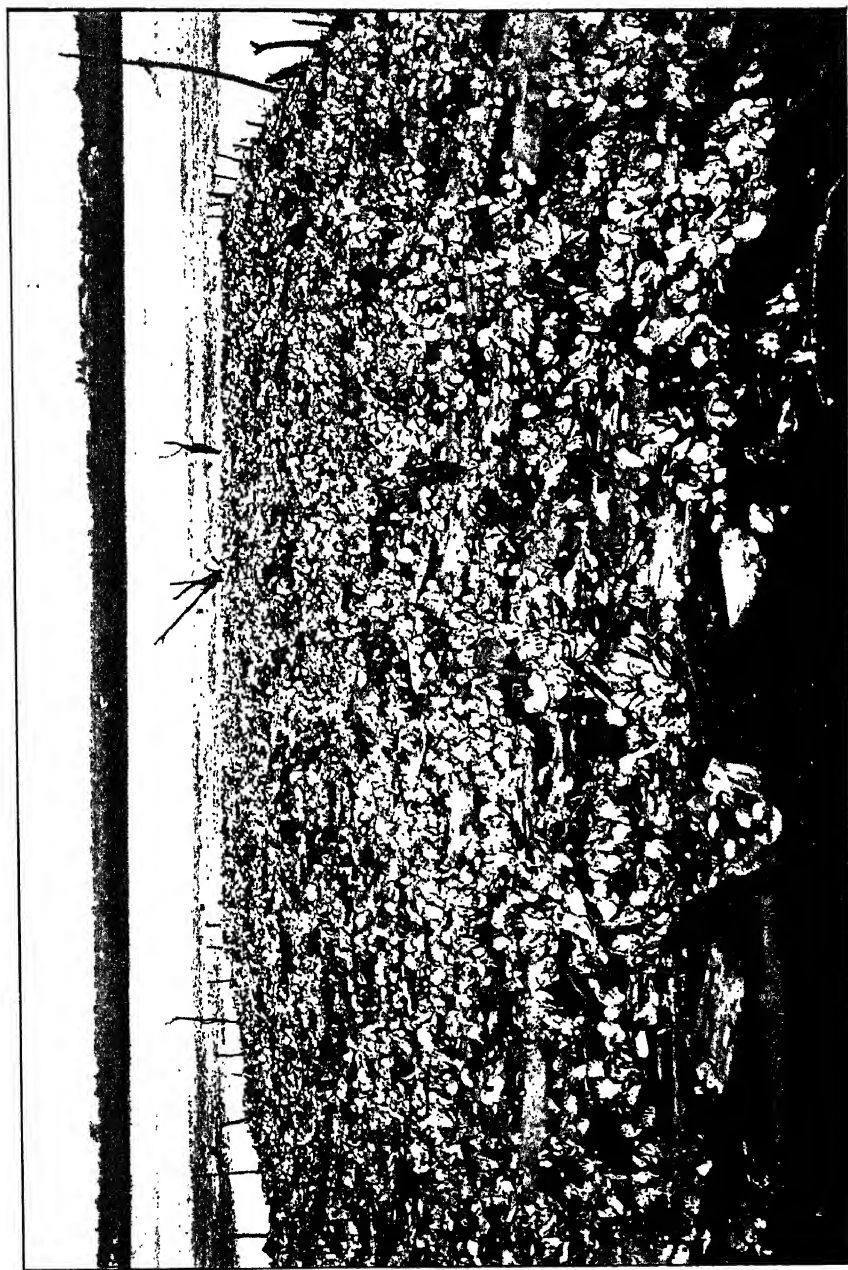
the Author.

FIG. 18. —TILES LAID FLAT ON A BUILT-UP MATURING BED,
WOOLLOOWARE BAY.

space between each piece of about 12 inches. Upon the latter the tiles are laid in a horizontal position. In this situation they collect considerably more silt than they would if laid upright, as in Fig. 17, and for this reason the latter method is more fruitful of result.

Ridge tiles have been used on the bed illustrated in Fig. 19. This is situated in Gwawley Bay, and shows a built-up maturing bed on which oak poles have been laid as a support for the tiles. The latter were purchased many years ago, and have borne several successive crops of very fine oysters. That illustrated is an excellent one, the oysters being large, clean, and of splendid shape.

Fibro-cement sheets are shown in Fig. 20, which is a view of portion of S. Lewis's lease in Woollooware Bay. They are arranged in pairs in long rows in a similar manner to the stones shown in Figs. 4 and 5, the lower edges sinking into the mud to a depth of about 3 inches. No preparation of the bottom has taken place. Most of the sheets seen in the photograph have been freshly laid out to await a setting of spat.



[the Author.]

FIG. 19.—RIDGE TILES AND TIMBER ON A MATURING BED, GWAWLEY BAY.

Photo by]



[Photo by]

FIG. 20.—FIBRO-CEMENT ROOFING SHEETS ARRANGED IN ROWS, WOOLLOOWARE BAY.

[The Author.]

Built-up Maturing Beds.

These beds were first constructed by W. E. Smith at Carter's Island, in 1901, and proved to be an immediate success, for not only did the oysters grow rapidly, but also remained practically free from the worm disease. As a result they at once found favour with other lessees, and their construction has been general and extensive on the flat leases until the present time.

They are built up in a manner very similar to the bed described on page 31, and, owing to their importance, a somewhat more detailed description is here given. The bottom in its natural state consists of soft mud, varying in depth from 1 to 2 feet. This rests on a firmer layer, composed principally of broken shell and sand. The area mapped out for the projected bed is covered with branches, twigs and leaves of swamp tea-tree,* which grows in close proximity to the foreshores. Channels are dug round the bed by removing the layer of mud, and the firmer mixture of sand and shell grit is shovelled over the tea-tree till the whole area has been raised about 12 inches, the tea-tree serving to bind the bed into a more solid mass. It is then raked over to make it quite level, and is left to settle, when a top-dressing of old clean shells is spread

* *Melaleuca ericifolia*, Sm.

over the whole area. These partially sink into the surface and serve the double function of binding and hardening it. The oysters which it is intended to fatten are carefully laid on the bed in a single layer, care being taken that the flat (right) surface is uppermost.

Fig. 21 shows a bed of this description under construction, the tea-tree bushes having been covered by a layer of shell grit and sand. The tide has partially risen over it, and consequently the channels surrounding it are obscured.

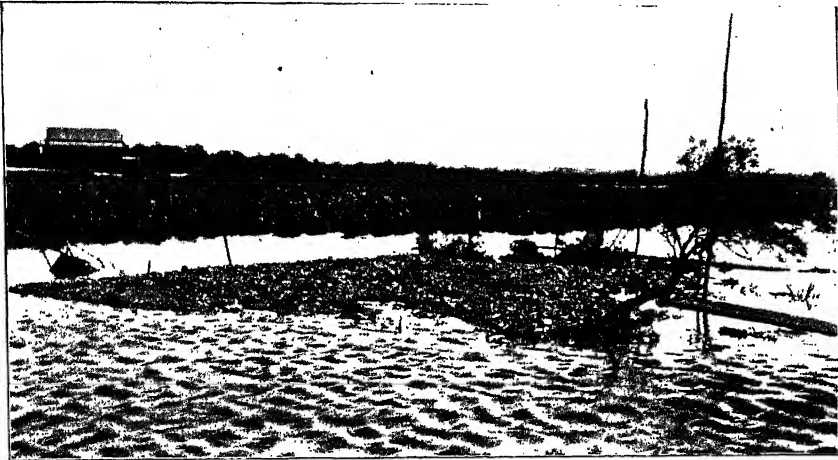


Photo by]

[the Author.

FIG. 21.—A SHELL-MATURING BED PARTLY CONSTRUCTED,
SHELL POINT.

The size of these maturing or, as they are sometimes called, "improving" beds, varies considerably, the average being about 30 feet square. Care should be taken not to construct them too large, otherwise they become difficult to wash down. This is accomplished by means of shovels or dishes, the water in the channels being thrown forcibly over the oysters, thereby removing any silt which may have accumulated. Mr. J. S. Smith recently experimented in Gwawley Bay with a pump and hose worked by an oil engine. The force of water, however, not only removed the silt, but also carried away much of the substratum, consequently its use was soon abandoned.

The oysters that are spread on the maturing beds are obtained from several sources. Those which grow on the bases of the mangroves and on the cobblers' pegs near high tide develop slowly, and never attain the size of those growing nearer the low tide mark, so that, when old enough to handle, usually about eighteen months, they are collected and placed on the beds to mature. In addition, when culling oysters for market, they are frequently found growing so closely together, sometimes adhering to each other, that it is impossible to remove the marketable oysters without also dislodging those which

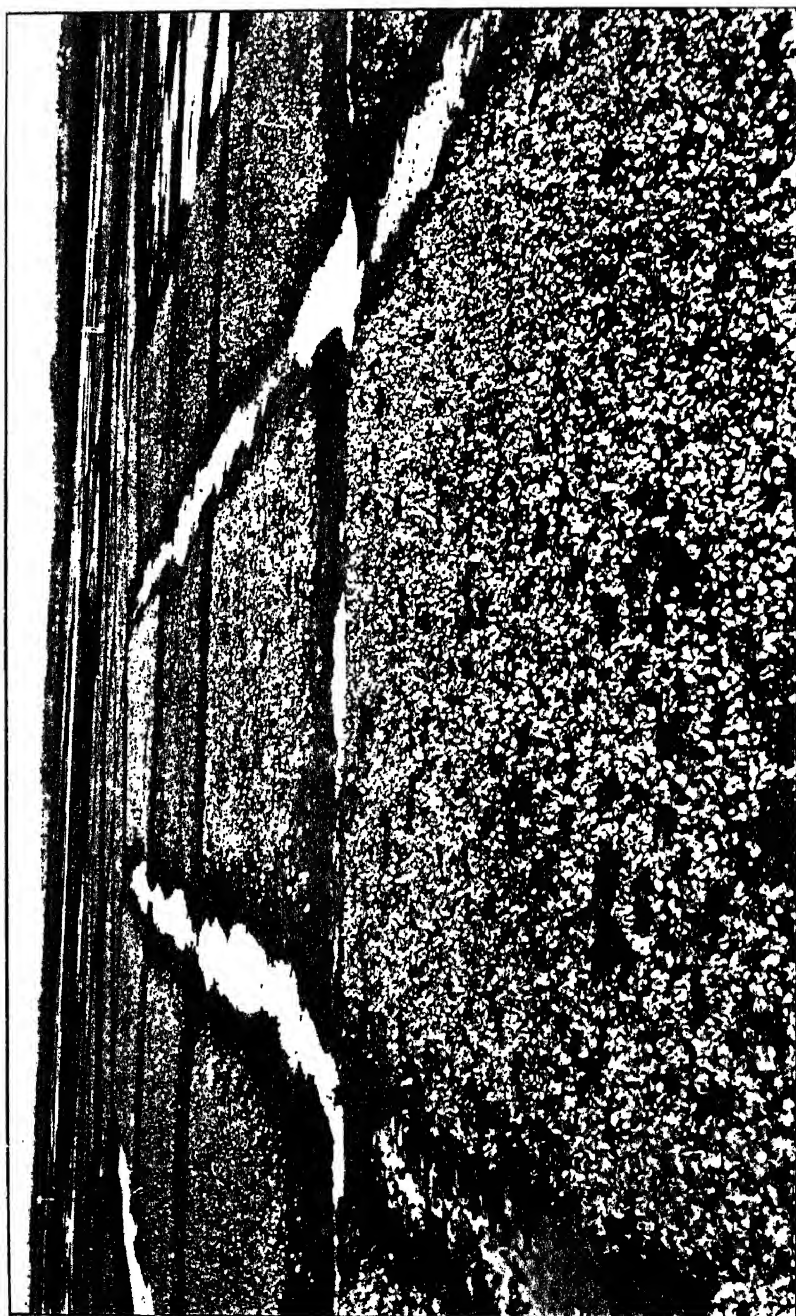


Photo by]

the Author.

FIG. 22.—AN EXTENSIVE AREA OF SHELL-IMPROVING BEDS AT WOOLLOOWARE BAY.

are still immature. The latter are carefully sorted out and placed on the maturing beds. Then, too, quantities are sometimes obtained from other rivers, such as Port Hacking, where the oysters are stunted owing to the salinity of the water. These develop rapidly into good, large, well-flavoured oysters. An extensive area of such beds is illustrated in Fig. 22, which shows portion of F. Selmon's leases (9192) in Woollooware Bay, near Shell Point. This is the most extensive shell bed cultivation on the river, and the whole of it has been developed during the last five years. The average dimensions of the individual beds are 60 by 20 feet, and they are carefully drained to low-tide mark. The cost of constructing them has varied from £10 to £20 each.

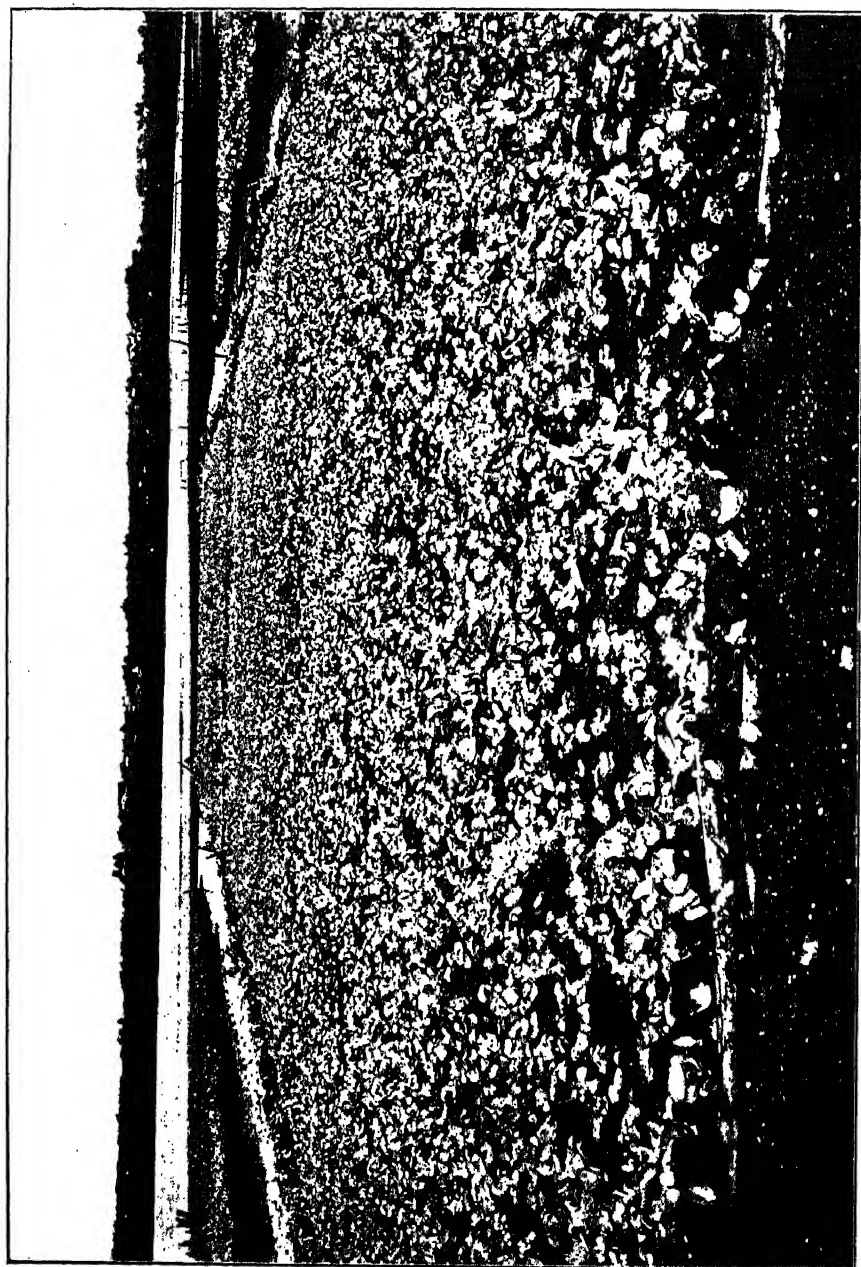
A somewhat larger type is illustrated in Fig. 23. This is one of many of a similar nature situated in Gwawley Bay (and owned by J. S. Smith), the dimensions being 50 feet by 33 feet. The channels draining the cultivation area are clearly seen extending to low-tide mark, and, in addition, the beds themselves are bounded by poles and stones to prevent the edges washing away. It will be noticed that precaution has been taken against overcrowding, with the result that the oysters have developed into very large and well-shaped specimens.

Wire-Netting Trays.

Another method of maturing young oysters is by placing them on wire-netting trays, resting on piles driven into the mud. Several of these are illustrated in Fig. 24, which shows portion of one (10,460) of F. Selmon's leases at Woollooware Bay.

The trays are constructed on shore of hardwood battens (3 in. x 1 in.) of uniform rectangular size of 20 feet by 8 feet. The galvanised wire netting of $1\frac{1}{2}$ inch mesh is stretched across this frame and nailed to the battens. It is then placed on and secured to piles previously driven into the mud to such a depth that about a foot projects at the surface. These trays are arranged in rows end to end, and extend from about half ebb tide to about small low-tide mark, in which situation the oysters grow most readily. In the case of the trays illustrated in Fig. 24, this distance measures about 50 yards. The oysters are carefully spread over the surface and are left to mature. They are obtained from the same sources as those used for stocking the shell maturing beds just described.

This has proved to be an excellent method of maturing oysters, and possesses several advantages over any other at present used for that purpose. Amongst these may be mentioned (1) the bottom requires no preliminary preparation whatever; (2) the height of the tray above the mud is easily

*Photo by]**FIG. 23.—A LARGE BUILT-UP BED IN GWAWLEY BAY.**The Author.*

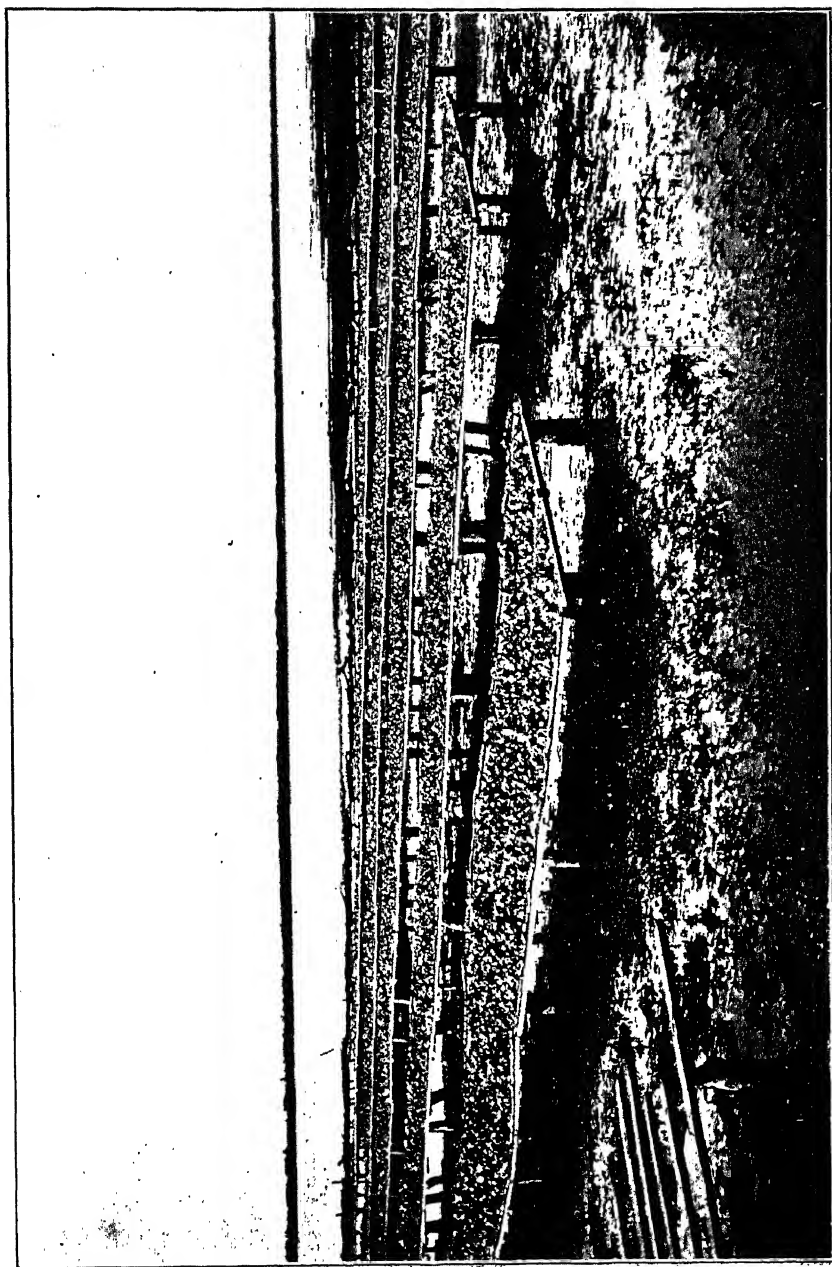


Photo by]

[the Author.

FIG. 24. - WIRE NETTING TRAYS USED FOR MATURING OYSTERS, WOOLLOOWARE BAY.

regulated by the length of the piles; (3) the amount of silt collected is reduced to a minimum; (4) the trays are easily carried ashore when the oysters are ready for market, and (5) they are particularly free from pests. There is, however, one distinct disadvantage, and that is the fact that the life of the wire netting in the water is very short, for after the lapse of about two years it decays rapidly. This has been partially overcome by W. P. Judd, who dips the wire in pitch, which prolongs its life for about a year.

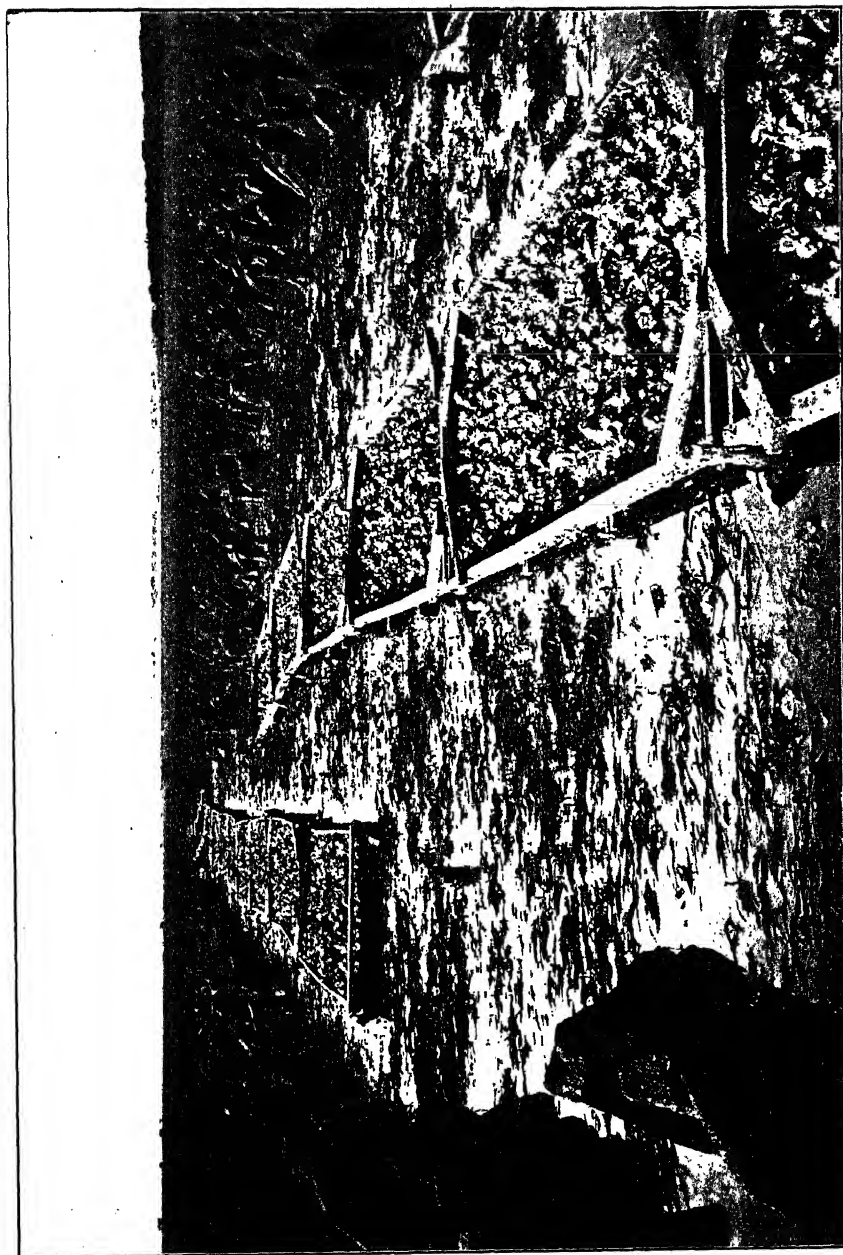
In the bottom left-hand corner of Fig. 24 may be seen hardwood battens nailed to a framework of swamp oak. These are being used as spat-catching surfaces, and not as a bed for maturing oysters, although hardwood battens are sometimes used for this purpose, in which case they are spaced about an inch apart only. Under favourable conditions the hardwood may last for many years in the George's River, but there is always some uncertainty pertaining to its use, for once it becomes infested with "cobra"* it perishes in a very short time.

Wire-netting trays are again illustrated in Fig. 25, and their construction may readily be seen in the photograph. They are each 10 feet long by 3 feet wide, and are placed 6 inches above the mud, the mesh of the wire being $1\frac{1}{2}$ inches. These trays, situated on a mud bank known as Farm Flat, at the mouth of the river, are wholly submerged at high tide, and are the property of W. Judd, a returned soldier. The whole of them, numbering twenty-six, have been stocked with small Port Hacking oysters by the other lessees on the river. It will be seen that under their new conditions the transplanted oysters have developed into splendid specimens.

Fig. 26 illustrates a typical stretch of foreshore in Yowie Bay, Port Hacking, thickly clustered with small, stunted oysters. They are growing on Crown lands, and may be purchased from the Fisheries Department for re-stocking purposes at 5s. per 3-bushel bag. The lessees divide the clusters into smaller groups of, say, three or four oysters, and then arrange them on prepared beds in the George's River.

The character of these Port Hacking oysters may be seen in Fig. 28, which shows them natural size. Most of these are many years old, as evidenced by the hard, crinkled shell and the numerous and close layers of growth. If allowed to remain in Port Hacking their development remains extremely slow, and a very small percentage indeed ever reach marketable size. Soon after their removal, however, into the more brackish waters of George's River, fresh, healthy growth appears round the edges of the shells, and in the course of about twelve months they double their original size.

* "Cobra" is the local vernacular name for the mollusc known elsewhere as "ship-worm," and belonged until recently to the genus *Teredo*. In the recent check list published by Mr. Chas. Hedley of the Australian Museum, the genus *Teredo* has been superseded by *Nausitoria*, of which two species have been recorded from the waters of New South Wales.



[the Author.]

FIG. 25.—WIRE NETTING TRAYS STOCKED WITH PORT HACKING OYSTERS FOR A RETURNED SOLDIER. FARM FLAT.

[Photo by]

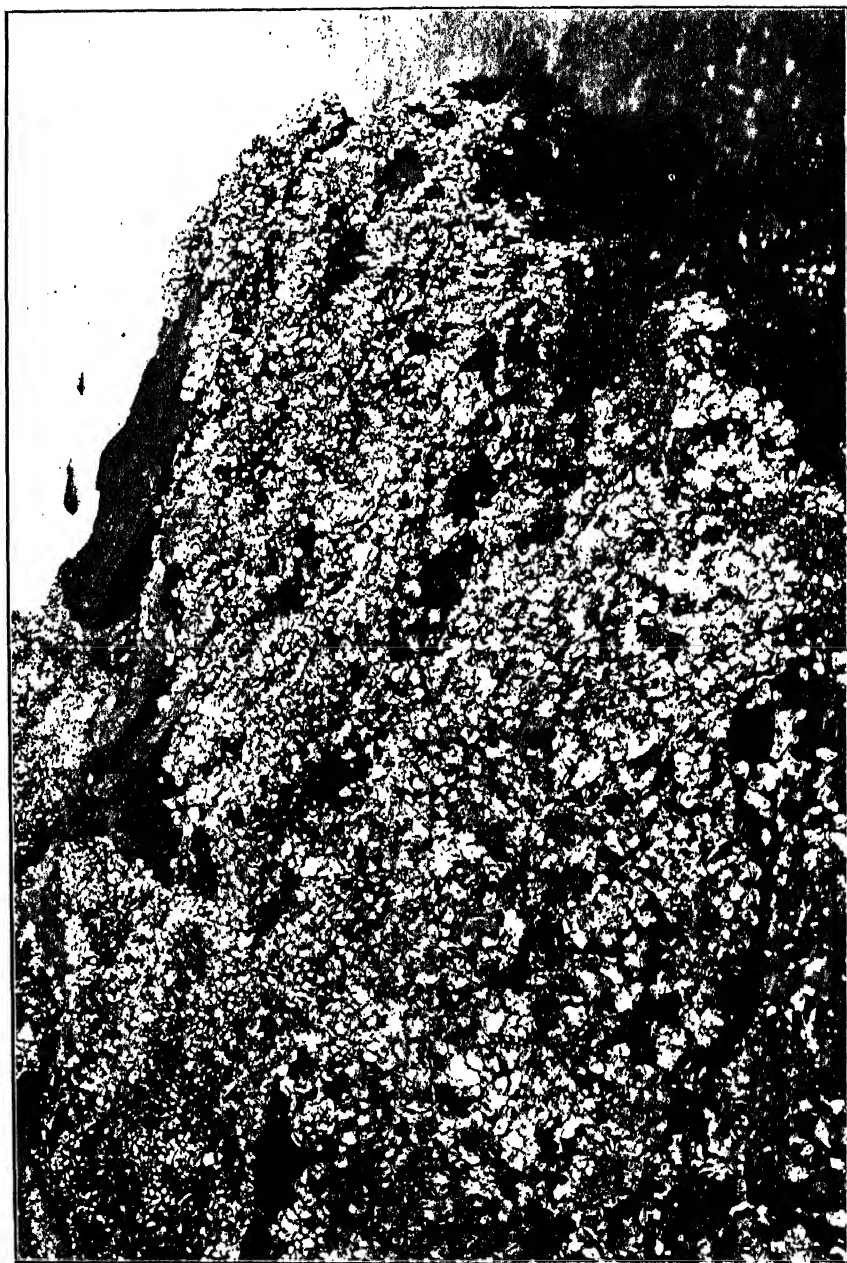


Photo by

Dr. Auker.

FIG. 26.--A TYPICAL STRETCH OF PORT HACKING FORESHORE SHOWING DENSE CLUSTERS OF STUNTED OYSTERS.

The oysters illustrated in Fig. 29, also natural size, were originally taken from Port Hacking, and were of a type exactly similar to those shown in Fig. 28. These were deposited in the George's River on the trays shown in Fig. 25, in November, 1919, and were collected in August, 1921, so that in the course of a year and nine months they have developed into really first-class marketable oysters of good shape and great depth.

A percentage of those transferred generally succumb after being laid out on the beds, due, in most cases, to the impracticability of sufficiently isolating the individual oysters. Notwithstanding this, it has been estimated that one bag of Port Hacking oysters will fill at least two bags after being allowed to remain for a couple of years in the George's River.

Destruction by Frost.

The destruction of large quantities of oysters by frost during recent winters was referred to on page 24. A mound of dead shells, the oysters in which had been killed in this manner, is shown in Fig. 27. These were collected on F. Selmon's leases in Woollooware Bay during the Spring of 1920, the oysters having died after a series of heavy frosts in August of that year.



Photo by]

[the Author.

FIG. 27. --MOUND OF SHELLS, THE OYSTERS IN WHICH HAD BEEN KILLED BY FROST, SHELL POINT.

The empty shells are not wasted, however, but serve a useful purpose in top-dressing improving beds, the surface of which they assist to bind and harden. In many cases, also, they catch quantities of spat, which is allowed to remain attached to them till it develops to maturity.

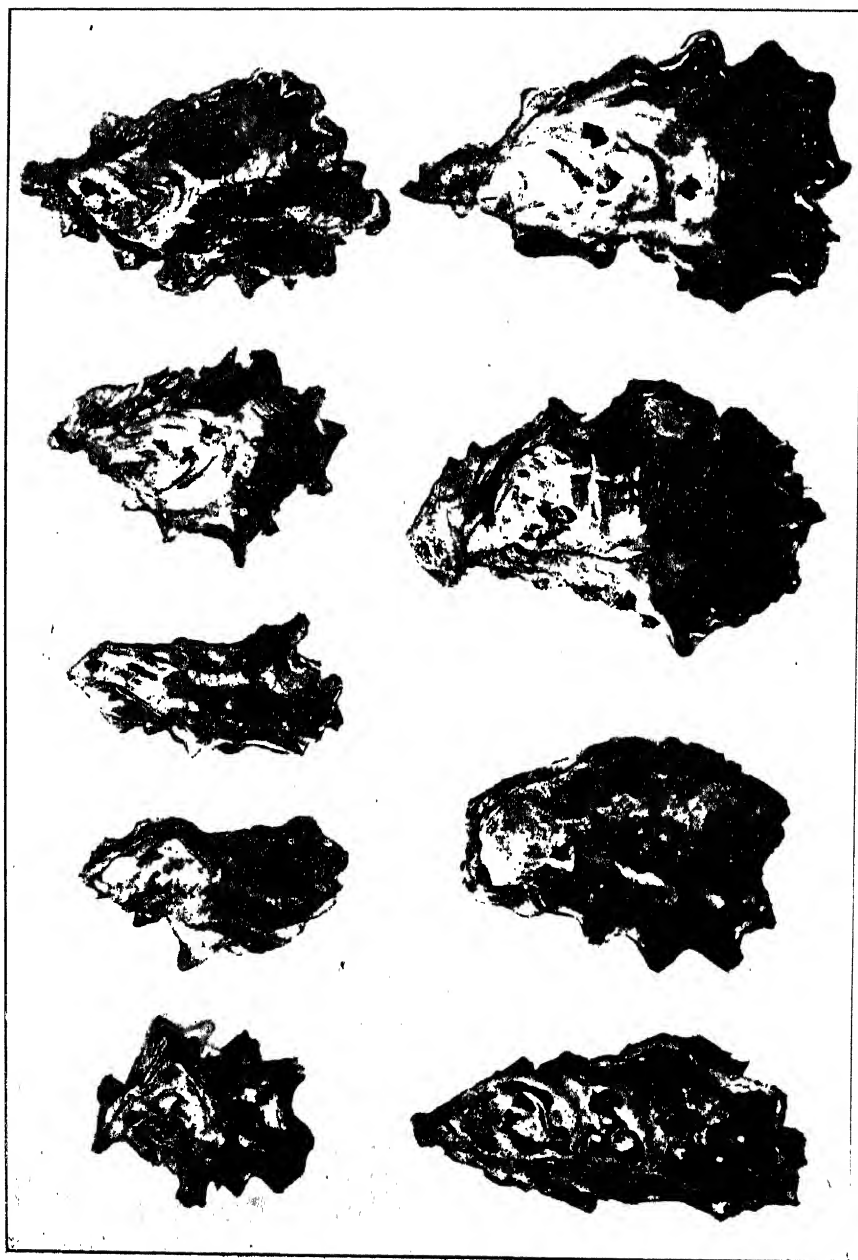


FIG. 28.—TYPICAL STUNTED PORT HACKING OYSTERS. NATURAL SIZE.

Photo by

The Author.



FIG. 29.—PORT HACKING OYSTERS AFTER BEING IN THE GEORGE'S RIVER FOR A
YEAR AND NINE MONTHS. NATURAL SIZE.

[the Author.

Photo by]

3. The Future Prospects of the Industry.

THE outlook for the future of the oyster industry on the George's River gives every indication of renewed prosperity. For many years the various animal pests have made no headway, but rather do they appear to decrease from year to year. For this the unceasing vigilance of the lessees in combatting them is undoubtedly chiefly responsible.

Practically the whole of the ground available for oyster culture is at the present time taken up, and the greater portion of it is under cultivation, so that the time is apparently not far distant when the resources of the river shall have been exploited to their full capacity.

There are several grounds not at present under lease which would make excellent cultivation areas, but over these the local fishermen regularly haul their nets, and the demands of the fishing industry have wisely guided the Department to reserve them for that purpose.

The severity of the winters of the past few years has certainly given the industry a set-back, resulting in a considerable decrease in the output for the time being, but the history of this occurrence, both in the George's and other rivers, justifies an optimistic view in regard to it. All available evidence points to the fact that it is of a temporary nature, and similar conditions may not be repeated for a decade. The winter of this year (1921) was a mild one, consequently no oyster mortality was observed. Seasons appear to run in cycles, and one may therefore reasonably expect favourable conditions for some time to come.

There is another factor, however, which, although appearing to progress slowly, is yet making inroads of a more permanent character on the industry. I refer to the construction between tide marks of boathouses, skids, private baths and jetties by the owners of land having water frontages. Permission may be granted for the erection of such structures, though their dimensions are limited by regulation. In recent years full advantage has been taken of

this " permissive occupancy " on many parts of the river, but more especially in the vicinity of Como. The area embraced by these structures is, of course, lost to the lessee, who is required to remove such cultivation as may be embraced by them. In the aggregate quite a considerable extent of oyster-bearing fore-shore has thus been forfeited during the past few years, and a further retrogression may be expected in the future.

Fortunately, the leases situated near the mouth of the river, where the great bulk of the oysters is produced, are not affected by this encroachment, and probably never will be, for these areas are so muddy and low-lying that the erection of baths and boathouses is not only undesirable, but impracticable.

Appendix A.

Annual Return of Oysters marketed from George's River from 1883 to 1919.

Year.	Bags.	Year.	Bags.
*1883 (July to Dec.) ...	926	1902	1,107
1884	160	1903	1,092
1885	245	1904	807
1886	No record	1905	777
1887	143	1906	1,097
1888	115	1907	647
1889	4	1908	894
1890	28	1909	923
1891 ... ..	...	1910	1,456
1892 ... ..	...	1911	2,248
1893 ... ..	...	1912	2,250
1894	12	1913	2,315
1895	27	1914	2,120
1896	265	1915	2,202
1897	506	1916	2,712
1898	878	1917	2,861
1899	1,365	1918	3,247
1900	1,456	†1919	2,146
1901	1,375		

* River opened to dredging only during the latter half of the year.

† Decrease due to the heavy mortality of oysters during the three preceding winters, owing to heavy frosts.

Appendix B.

Statement of Expenditure incurred in improving Oyster Leases.

The data set out below will serve to convey an idea of the cost of cultivation on the George's River. They are taken from books kept by the lessees.

1. Oyster Lease No. 9737, situated in Woollooware Bay, near Shell Point, and owned by Messrs. Selmon and Lewis. This lease is in two sections, and embraces an area of 11 acres :—

100,000 stone slabs, 2 ft. x 1 ft., @ £5 per 1,000...	...	...	£	500
Towing by launch—200 trips @ £1 per trip	...	...	...	200
Wages—Two men and one boy for 12 months...	...	...	...	405
Hire (or depreciation of punt) for 12 months	...	...	...	50
Royalty on stone slabs @ £1 per 1,000	...	...	...	100
Timber purchased for use with stone	...	...	...	150
Total				£1,405

It therefore cost, approximately, £14 for every thousand stone slabs erected into position.

The above improvements covered 9 of the 11 acres, and were completed on 30th December, 1919.

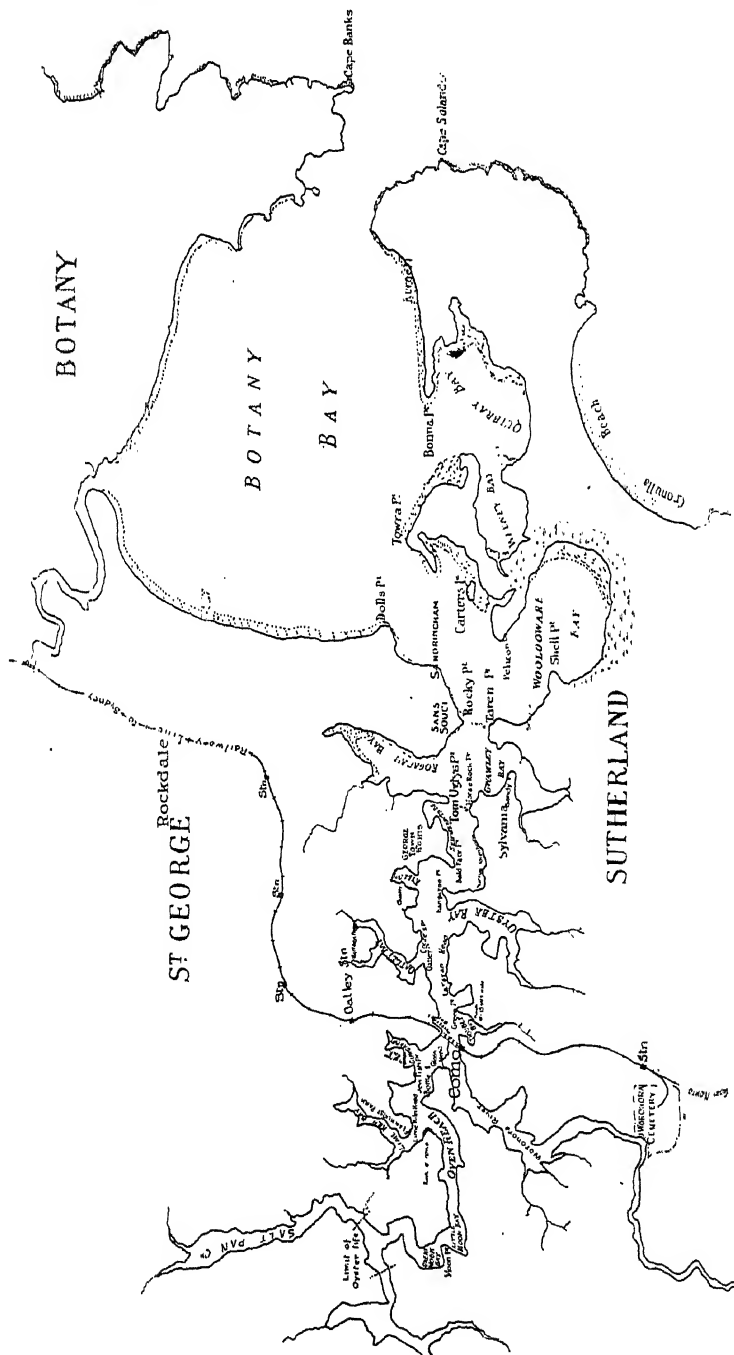
2. Oyster Lease No. 8,951, at Farm Flat, between Pelican Point and Sandringham, owned by Major Lamb, and covering 8 acres :—

	£	s.	d.
4 shell beds, 50 ft. x 25 ft. x 9 in. high	48	0	0
1 shell bed, 25 ft. x 14 ft. x 6 in. high	3	0	0
10,000 stone slabs laid out on lease	100	0	0
180 oak poles erected on lease	5	0	0
150 oak poles supporting stones	4	0	0
3 small tea-tree beds	3	10	0
Total	£163	10	0

Two only of the 8 acres were covered by the above improvements.

3. Oyster Lease No. 7,185, situated at Pelican Point, and owned by W. E. Smith. This lease embraces an area of 20 acres, of which about 10 acres have been covered by cultivation as follows :—

100,000 stone slabs laid out, cost complete, £1,200.



MAP OF GEORGE'S RIVER
FROM ITS ENTRANCE INTO BOTANY BAY, TO THE LIMIT OF OYSTER LIFE.

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Sydney :

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1922.

